Design Domains
THEIR RELATIONS AND TRANSFORMATIONS AS REVEALED THROUGH THE PRACTICE OF PAUL MINIFIE

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THROUGH THE PRACTICE OF PAUL MINIFIE

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DECLARATION

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.

Paul Minifie
September 2010
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Proposition
INTRODUCTION

This document provides an account of a series of architectural projects that have been completed under my direction in the offices of Minifie Nixon Architects' over the last decade. The projects range from small theoretical projects through to several more substantial constructed projects.

This document begins by introducing several concepts used in the later projects' description. It moves to a detailed account of each project. Antecedents and important reference points are briefly surveyed. A section follows which responds to commentaries by critics who have discussed germane aspects of the work. Finally, the document is concluded by speculating on how this account may inform future architectural projects.

As a practising designer I have a different mode of access to my own works than I do to that of others. It is not possible to fully and critically examine my own projects from outside, freed from the intentions of their author. Instead, the project accounts here try to outline the constructive concepts and methodological traversals involved in their production.

Many of the projects have been reactivated by this process of reflection, with the project outcomes folding back into their genesis to suggest future development that might activate latent themes and methods. It is this glimpse of a deeper and more consolidated future practice that has been a key benefit of undertaking this work.

I am of the first generation of architects who has worked with computers as an integral part of everyday practice. Seen from one perspective these projects reflect an examination of the workings of computation, and comprise a speculation on how those workings might re-propose architectural themes and transform architectural effects. Put loosely they propose that operations

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1 Reflecting a change of directorship, the offices of Minifie Nixon Architects changed their name to Minifie van Schaik Architects in August 2010.
and methods intrinsic to computation can reformulate, in positive and sometimes unexpected ways, closely held patterns of architectural thinking.

This kind of investigation, as an architect, into computational methods also reformulates the usual intentions of that computation. Seen from that vantage, computation is no longer directly about instrumental issues of problem solving, optimisation or connectivity. Rather the methods of achieving these things are selectively picked over and re-purposed to illuminate architectural concerns. This re-purposing is discussed in more detail in a latter conversation titled 'Techne Trouve'.

It is important to state that these projects make most sense in the context of a commitment to the discipline of architecture, whatever that means, in all its protean depths and breadth. Projects are finally of interest in the way they intervene in the domain of cultural concerns that can be plausibly said to constitute the discipline of architecture. An examination of concepts from mathematics, computing, and occasionally economics and biology are a means to architectural ends.

I use some of the terminology from these other fields in the descriptions of projects. Often these terms are used because they best describe a concept that has no easy equivalent in standard architectural equivalent. Many architectural terms are so overdetermined, so overloaded beyond their definitions that they no longer have utility. I hope that by importing and re-purposing the occasional word can help provide another perspective and evocation to architectural actions.

Although I often refer to architectural themes in a general sense, the particular conception of these themes as a bounded group susceptible to transformation by propositional operations is most likely a located one, common to a group of Melbourne architectural practitioners and one pole of the RMIT community. While I only briefly discuss the particular accents and tropes of my local milieu, in the section on antecedents, I acknowledge
that some of the matters I discuss, even though seeming quite general, might well carry a singular kind of sense in that context.

An important counterbalance to these sometimes tribal discursive interests lies in the lived life of the buildings: might an aware inhabitant of a proposed building reasonably apprehend and respond to the concerns from which the building emerged? Although not a direct subject of this discussion, constructed projects from the office try to directly and generously engage with an interested public. In the attempt to express the process of a building’s becoming, we seek to make that thinking an intrinsic attribute of the building’s operation.

It seems important, as a practitioner, to be able to provide an account of a project that has a demonstrable correspondence to identifiable attributes of the artefact as it stands alone. This is perhaps not such a pressing concern to a critic who may seek to locate a project within a broader context. To a practitioner however, an account is most useful when it can be used constructively to inform a means of making. A forward mapping is necessary for an account to be constructive. Perhaps more interesting is the question of the backward mapping: from the artefact back to the operative concerns of the project. Although often left implicit, the possibility and implications of these constructions and reconstructions are one of the subjects of this work.

To be able to address these questions, I have attempted to sketch a model that delimits possible actions, and provide an explanation of both how these actions are undertaken and how a resulting artefact might relate to things beyond itself. Attempting such a thing is on one level absurd: it can never plausibly account for the broad phenomenon that is architecture. Perhaps, in its oversimplification, it can capture some of the operational logic at work in the projects.
DOMAINS

A design domain contains an internally consistent set of elements and operations that can be combined to construct building instances.

This description of the place from which architecture comes is deliberately sparse. In its reduction it tries to capture how the intrinsic qualities of matter and information provide both the mechanisms and limits of what can be made. At various points throughout the project descriptions I refer to design domains as being constituted by particular relationships of information that can cause arrangements of material things. For example in the description of the Centre for Ideas project, I discuss how the relationships inherent in the Voronoi tessellation can lead to an ordering of building elements that is quite different from and incommensurable with the kind of arrangements that might derive from working within a Cartesian gridded space. I offer the Barcelona Pavilion as something of a straw man in exemplifying an instance of the later. Cellular automata, energised surfaces, and aggregated economic decisions are examples of other structured relationships I later characterise as constituting design domains.

The notion of internal consistency is important. It suggests that only some elements and operations can make sense, but from those, more complex structures can be assembled.

A design domain is a neutral place of potential things. There are a hyper-astronomical number of different potential instances that might be produced by a given domain. It is not until an instance is realised from the domain that it can posses specific appreciable qualities.
TRAVERSALS

A traversal is a particular sequence of operations within a design domain that leads to the realisation of a specific building instance.

An analogous architectural concept is composition. Elements are bought together in accordance with an underlying rule system of the design domain into a particular and complete set of relationship with one another. A traversal is where architectural disciplinary skills come into play. Specific traversals bring to the fore a particular assemblage of building qualities and attributes.

The series of energised surface projects show how alternative groups of operations can make different sets of formal qualities available to architectural consideration. A more specific material example of a traversal is given when discussing the design decisions involved in resolving the Centre for Ideas facade.

It is this different set of qualities that emerges through a traversal of a design space that enables a project to posses a valency - that is, the ability to form plausible associations and connections outside itself.
INJECTIONS

An injection is a mapping between elements and properties of a building instance, and some object or phenomena external to it.

Such a mapping might occur through reference or association. The choice of the golden fabric for the Costa surface structure in the Australian Wildlife Health Centre (AWHC) can serve as an example. The gold colour shifts possible associations away from that of an abstract reading towards a comparison with domed structures found in other architectures. Similarly, the choice of a reflective material for the Centre for Ideas facade enables an understanding of the building as being not fully materialised, its shimmering being suggestive of the presence of a virtual realm in which the building may still partially reside.

Mappings might also be established through patterns of use. The proposed pattern of atomised and interrelated activities posited in the Volute project may serve as an example. Or the mapping might take place through an affective or perceptual impression, such as when first apprehending the ceiling of the AWHC.

This pattern of potential correspondence relationships latent in the project is ultimately enabled by the properties of the constituent design domain, and the specific instance realised through its traversal.

It is difficult territory for an architect to attempt a definitive reading of her own project. Certainly it feels hubristic to try. Further, there is a fear of creating a strained closure which by extension will function to constrict the expressive scope of future projects. By using the terms valency and mapping I am trying to allude to the specific ability of a particular building to establish relationships beyond itself, rather than detail exactly what those relationships might be.
While the sequential nature of this exposition suggest a linear development, the experience of designing in this model is in fact iterative and unstable. Design domains cannot be known until an attempt is made to traverse them. Many are rejected as non-viable. A rich and coherent injection only emerges in a fragile stability after many compositional refinements.

It is perhaps constituent of our projects that we favour an injection supporting multiple mappings. Further mappings are preferred that can destabilise the context of the the thing to which a connection is made.
Projects
Streaming Houses

STRANGE PROCEDURES AND THEIR MISUSE

2002-10

Tracing the pilgrim’s progress through the Barcelona Pavilion

Frames

Structure edges lofted to form volumes  Some volumes excised
“And the Tigers were very, very angry, but still they would not let go of each others’ tails. And they were so angry that they ran round the tree, trying to eat each other up, and they ran faster and faster till they were whirling round so fast that you couldn’t see their legs at all. And they still ran faster and faster and faster, till they all just melted away, and then there was nothing left but a great big pool of melted butter round the foot of the tree.”

From a Banned Book

The architectural pilgrim at last visits, perhaps from Australia, the font of it all, the reconstructed Barcelona pavilion. Video camera in hand she moves through the space, eye on the screen, carefully keeping the verticals parallel to the frame, and in a moment of recognition, captures the corporeal affirmation of that drawing where the cruciform column floats autonomously in front of the texture-mapped lushness of the onyx wall. She moves forward among the glass walls, un-present but denoted by their steel frames - they trap the cowering female sculpture in their congruent golden (but never gold) rectangles. More walls, travertine and olivine, the constant white ceiling plane overhead, then... she is back to where we started... but that can’t be all, so again... and another go, one more time, in case there is, as surely there must be, something more.

The data from this camera sits as an inert block. When rendered to a screen for friends at home, successive layers of the block are sectioned at precise intervals to represent the visual field of our holidaying architect. Streaming House proposes we cut the data another way. By regarding our block of data as congruent in structure to that gathered by a CAT scan machine, we can establish boundaries around the summed appearances of the structures within the pavilion. Columns, walls, roof, floor, sky and surroundings views become separate volumetric entities, distinguished from each other in the same way as organs are in a tomographic scan. If the motion path is a closed loop, the volume can be bent to join start with end and so form a closed and continuous torus, making a kind of accelerator only just containing the functions of the house, which constantly recombine and stream out.

A kind of strange procedure is thus invoked, based on a misapplication of a medical imaging technique. An isosurface mapping is a way of using ultrasound data to show the internal organs and structures of the body without having to cut into that body. Digital data and procedures of this sort tend to be motivated by imitating some aspect of the world. This mimetic intent and the procedure itself can be uncoupled. So here, instead of reinventing the house, a medical method can be applied generatively...
whereby the ultrasound data is switched over to that streaming from a video camera.

The modern pavilion is wrenched from its pretty siting between idealist Cartesian space and a world of mechanical production. It seeds the procedure by providing a sequence of views as we walk through. Isosurfaces are then made to locate structures within this sequential stream of images.

The result is a transformation; a derivative of the Miesian function drawn by the traversal of the architectural pilgrim. This idea of ‘making’ contains and connects concepts of motion, perception, visibility and an architecture past. The project tries in this way to educe a kind of sense for living now, or for living soon.

Many of our works have been, lets call them, *relational projects*. They have investigated the reification of abstract entities or relationships into architectural matter through machine-like processes. *Streaming House* differs in that it readmits the contingent dross of the world as material for transformation.
If a relational project can engage a viewer, it is through correspondence between itself and her experience of how things work in the world. It involves an empathic relationship between the becoming of the architectural object, and the becoming of the viewer. A tree and its movement, my phone’s signal failure, the collapse of a stock-market, the dancer’s *fouette* produce patterns for a viewer’s understanding of constructive relationships. If the relational project can be legible, it is through this patterning from the real.

But then a sleight is committed in service of architecture’s great unspoken and undead idealist impulse. Internal relationships, so pulse the constituent memes of our designerly unconscious, are always better than those *de trop* external ones. So if we could just establish that Emergent Relations can be apprehended somehow completely and directly, then material excesses and troubling referential adherents can then be excised, and we could claim again to build the *noumenon* itself.

The Streaming projects try to allow back just a little of that ostracised *materiel*.

*Streaming House: She Dervish, 2010*
Streaming House, 2004
If a relational project can engage a viewer, it is through a correspondence with her experience of how things operate in the world. It is an empathic relationship between the becoming of the architectural object, and the becoming of the viewer. The FullHD-Cam teamed with an isosurfacing procedure forms a machinic tool for taking an architectural derivative from a lived flow. Streaming House redesmits the contingent dross of the world as material for transformation.
The Nine-Square Inflation
A PUMPIN’ MASHUP OF AN OLD-TIMES STANDARD

Nine-Square Inflation: steps 1, 2 and 3, 2000
This tiny project was a first exploration of surfaces defined by minimising their surface energies. The project dates from 2000. At the time it seemed pressing to find an architectural context for what was otherwise a fairly heteroclite approach to making architecture. So the project picked up the nine-square problem as formulated by Hejduk and the Texas Rangers, and in so doing hoped to place itself in a conversation that included, as precursors, Palladio via Wittkower1 and, as sequels, works such as Eisenman’s House III.

Energised surfaces are a broad class of surfaces that find their shape such that the forces acting on them are in equilibrium2. In this case, the forces at work were analogous to the physical idea of pressure. The nine squares were projected to cubes, and each was assigned a different pressure. The bottom of each cube was constrained to lie in a plane. While the concept of pressure can be understood as a mimetic simulation of a physical system, this final constraint makes less sense in a mimetic context. Instead it is more to do with the architectural fundamental of the ground plane.

We scripted the outputs from the physics software Surface Evolver into our CAD package to achieve the project3. It is worth understanding how Surface Evolver’s algorithm works. It starts with a mesh – defined by vertices, edges, and faces. The forces on each vertex are calculated based on its local geometric relationships, and the vertex is then moved to a new location where its forces are closer to equilibrium. Only one is calculated at a time, but each of the neighbouring vertices is also moved in a similar way. Because this affects the forces bearing on earlier vertices, the process needs to be repeated iteratively until each location is stable within a tolerance. Once the shape is within tolerance, the faces can be subdivided, and the process repeated until finer and finer segmentation is achieved ultimately approaching that of a continuous surface.

Like most algorithms, it is a bit of maths, and a lot of cooking. At the level of the mechanics, it is no mystical embodiment of the cosmos within the machine. But to me there was something of the wonder of the world, dragged into a simple method of making. More in a moment.

2  Joseph Plateau in his 1873 book “Statique Expérimentale et Théorique des Liquides soumis aux Seules Forces Moléculaires” first formalised a study of the physics of energised surfaces. He is better known for demonstrating the first moving image. His investigations into image latency involved staring at the sun for protracted periods of time, resulting in his blindness. A century or so later, a lag of comprehension not unusual for architects, Frei Otto introduced some of Plateau’s ideas to the world of buildings.
3  http://www.susqu.edu/brakke/evolver/evolver.html
Formally, and it is nothing if not that, Eisenman’s House III restricts its design domain to the affine transformations. Affine transformations are spatial transformations that preserve co-linearity and ratios of distance, and include translation, rotation, scaling and (not used by Eisenman until later projects) skewing. An interesting observation in this context, this domain can be represented mathematically as a 3 by 3 transformation matrix that can be applied to input points to derive the transformed geometry. In comparison with the procedure outlined for energised surfaces, these transformations are all maths and no cooking. Working compositionally to bring forward a dim resemblance to Le Corbusier (as mediated by Colin Rowe) Eisenman was able to make a series of intentional claims about this series of work, in which he argued for an autonomous formulation of architecture - described as a destruction of the symbolic, representational and anthropomorphic content previously intrinsic to architecture, including within modernism in its residual form.

It is interesting to compare this work to Robert Lazarini, a sculptor who uses similar consistent spatial transformations to those used by Eisenman. His work consists of highly detailed models of common objects, accurate in rendition of material colour and texture but highly distorted spatially.

I had seen his show at the Whitney in 1999, and was impressed by the perceptual impact of the work. Each piece was isolated within my field of vision. As I looked at a work, my mind seemed to apply a reverse spatial transformation in order to restore the object to normalcy. As my gaze shifted to an adjacent work, it was accompanied by a rapid disintegration of that transformed space that was accompanied by my literal bodily loss of balance, even though I was still standing in the Whitney.

4  “Conscious of the initial efforts of modernism, the houses of this book take up anew the project of autonomy, in a sense, take it up for the first time and use it to dislocate that traditional symbolism of modernism. This project consisted of two parts: first, the search for a way to make the elements of architecture - the wall, the beam, the column - selfreferential; and second, the development of a process of making that could produce selfreference without referring to the formal conventions of modernism. The elements were the freestanding column and the free plan of Le Corbusier. The result is an attempt to free the house of acculturated meaning whether traditional or modern. When conventions and external referents are stripped from an object, the only referent remaining is the object itself. Hence, all those extraneous meanings like the column as a surrogate for a man’s body, doors and windows oriented in relation to man’s verticality, rooms scaled to his size, ordering principles and plans in conformance with the classical hierarchies - all of which, however, remained disguised in the work of modernism - have been suspended.” Peter Eisenman, *Houses of Cards*, 1st ed. (Oxford University Press, USA, 1987), 172.
Lazzarini was working within a similar design domain to Eisenman, but traversed it in a markedly different manner to bring forward a different set of intentions. Aspects of representation and empathy were central to the mechanics and meaning of the work. It’s perceptual and bodily torque added an uncanny leverage to a more familiar sense surrealist estrangement from an object’s usual valency.

There are limits to the import that can be placed on a project so small and undeveloped. While it could be understood as an Eisenman Detournement, there are certain elements common to some of the other works described here.

The project is an instance of techne trouve; the seeing of algorithms as a kind of rich and precise formal procedure that can nevertheless be re-purposed in an adhoc way. Here retaining some component of the modeled phenomena is important. But the intention is not that of the physicist who constructs truthful descriptive and predictive relationship to that phenomena. Rather it is to introduce into architecture a rich set of internal relationships between components that can be understood analogously, perhaps empathetically, with selective aspects of things we already know from having lived in the world.

Our borrowed algorithms give us access to the tensions and energy equilibria of non-rigid bodies. But the forces at play in the Inflation are not naturalistic, having been precisely modified through the addition of a ground-plane constraint.

Compositionally, in manner similar to Eisenman’s reliance on the memory of Corb, the 9-square Inflation in turn maintains a resonance with the canonical 9-square structure. The Inflation uses a transformation (almost as) rigorous as the affine set more familiar to architects, but implies quite different kinds relationships between its parts and so to the viewer.

We started with bubbles, whose properties of surprise and wonder have stayed with us since our childhood learnings. If these can become material for architecture, it is by finding a method that can precisely capture and denaturalise their qualities, so making them available for compositional acts. Through those compositions, we can create resonances with other extant architectural structures so that they too can be part of the amalgam.
Manifolds

Schoen’s unnamed minimal surface 12

Harbour Study, 2001

Corner Study (upper) & Harbour Study (lower), 2001
This series of projects follows from the 9-square Inflation project, in that they continue to explore surfaces whose shape are determined by their surface energies, but unfold their architectural implications in different ways.

If not otherwise coerced, things will find their own shape, one that minimises their energy state. Water tends to droplets in a vacuum, and a plane in a millpond. An elastic membrane held in a frame will hold its shape in an equipoise of tensions such that its surface area is minimised. In contemplating any point on such a membrane, it becomes clear that the surface curves in two directions, both into and out of the surface. In a minimal surface, this curvature sums always to zero, that is, the mean curvature at any given point is the same as that of a flat surface. Considering further a sub-portion of such a membrane, it is clear that it is held in its shape not by the frame, but by the surrounding area of adjoining membrane. It is possible to have a membrane of a shape such that it can link to similar units in a way that maintains the zero mean curvature condition at their boundary. These units can fill space continuously without edges. Surfaces comprised of these units are known as triply periodic minimal surfaces. Many different configurations of these surfaces have been described and have terrific names: Gyroid, Mantra, Diphenoïd, Starfish, Fischer-Koch S-surface and so on. They are strictly minimal, but in a rather baroque kind of way.

These studies take different properties of these surfaces and investigate them with a mind to teasing out certain properties that might be made available to architectural thinking.

**HARBOUR STUDY – THICKENING**

The building type of the slab block can be understood in relation the geometric entity of a datum plane. To become a building that plane is rotated, translated and, crucially, thickened. It is the bestowing of thickness that takes the plane from an infinitely thin and thus abstract entity to one that can be conceived of as volumetric, and hence proto-architectural. Only then can it be punctured, surfaced and inhabited. Architects work by traversing the domain of possibilities established by this incursion from the abstract. Certain relationships can be bought forward or made to recede. An articulation of the facade might explore a relationship between individual dwellings and the larger form of the building, perhaps (in some time past) with the intention of drawing a kind social or political analogy.
Harbour Study, 2001

Corner Study, 2001
'Harbour Study' proposes a similar kind of thickening, in this case of a continually curving surface (in the 'Schoen’s unnamed Surface 12’ configuration). But unlike the slab this thickening is constrained by an inherent geometric limit which is the threshold beyond which the surface intersects itself. For this thickness to be considered as a building, the entire surface must be scaled. An infinitely thin, scale-less, abstract entity thus acquires a real world metric, and so becomes available to architecture.

Each building is composed of similar components rearranged to form quite different vesicular instances. A 'sided-ness' is maintained, one side being defined by the tracking of access and the perforations of structure, while the other is inhabited. An apartment is located as a particle in the 2 dimensional space of the surface. Unlike the case of the plane, the location in 3 dimensional space varies not just in all three coordinates, but with the orientating normal as well. Each apartment is a part of the whole not as a tile or brick so much as a sequin or bristle.

**CORNER STUDY – SPATIAL DIVISION**

'Corner Study' investigates another aspect of this surface class. Triply minimal periodic surfaces partition space into two distinct and continuous interlocking regions of space, in a kind of crystalline structure.

Corner study maps this spatial duality present in the 'Batwing' surface onto the architectural distinction between public and private space. Each of these distinct regions allow a continuous traversal through the structure. The building is a kind of aerated foam, expanding into the site. One of the partitioned spaces is inhabited and private, comprising apartments that are linked spaces connected on the diagonal. The other is public space enfolded into the building. Connected to the ground plane, it forms a continuous grotto interlaced with the enclosed spaces; a series of plateaus ascending through the structure. The conventional assumptions about public space as residing primarily in the street, and private space being contained within the envelope of the building are rephrased in an unexpected way.
Volute, 2005-10
VOLUTE - CONNECTEDNESS

Topology is an extension of geometry that removes metric properties as a condition for congruence. It is therefore the pattern of connections that are possible on an object that comprise it’s fundamental description. One way of examining topological objects is by drawing closed loops on their surface, and then shrinking those loops. We can classify the surface based on whether the loops can be shrunk to nothing without cutting through the surface. With this thinking we can see that a cube and a sphere are congruent, but a sphere and torus (doughnut) are not.

A graph is a diagram which shows how entities are connected together. Patterns of connectedness are important in describing emergent systems, where individual elements determine their state with respect to those of other elements to which they are connected. A city is an example of such a system. Topology is useful in examining patterns of connectedness. Many graphs drawn on a flat plane cannot be drawn without some connections crossing others, however an uncrossing version of a graph may be drawn on a surface of a non-planar topology. Different underlying surfaces, therefore, support different patterns and possibilities of connectedness.

Counterfactual history asks how things may have unfolded should a single event have happened differently. This virtual, parallel history serves to render the contingency of certain circumstances more evident, in order to bring into sharper relief the structures of causation. An architectural counterfactual might ask how a building could acquire a different valency, should some kind of existing constraint be removed.

Volute proposes a counterfactual whereby vertical transport moves freely in two dimensions across the outside of an ‘energised surface’ building, under the guidance of some novel personalised command and control mechanism. An iPhone perhaps.

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1 This mechanism recurs as the basis of science fiction narratives. Some entomological examples: the Fly (movie, 1958), or The Metamorphosis (Kafka, 1915). In both cases we are asked to suspend disbelief on a single point. The consequences and actions that follow are motivated by a familiar human logic, but with an added intensity deriving from the strangeness of their context.
Volute, impressionistic views
Cities are tyrannised by their ground planes. As we move through the streets, we can respond spontaneously only to what presents itself within our field of vision. Connections between activities and events are largely limited to adjacencies on the plane. Volute takes this planar surface, allows it to billow and aerates it into a continuous foam. Our counterfactual crawler lift give us the means to traverse our structure and our guidance device bestows an extra-sensory spatial knowledge consonant with our desires.

What takes place in Volute? First, let’s atomise any broad concept of function into highly specific actions and events. Then postulate that the viability of a particular activity is enhanced by relationships of proximity with other complementary activities. It is a phenomenon we see everyday in cities where, for example, fashion boutiques or motorcycle stores cluster together to share browsing customers, and survive by finely differentiating their offerings. Volute at time $t = 0$ is randomly seeded with activities. At $t = 1$, more activities have come into being, nurtured by their adjacent complementarities. At $t = n$, new synergies continue to occur between adjacent activities. Volute is teeming and continually seething: certain activities die, replaced by others more able to take advantage of the connections that particular locations afford.

Volute describes an alternative kind of building armature, one that supports an ecology of novel and differentiated activities, each with radically different properties of almost dendritic connectivity. Each node can fully exert its trophic influence on it’s neighbours, converging to a dynamic equilibrium existing somewhere between the flickering of lives and the staidness of buildings.

2 An observation more romantically expressed in the oft cited phrase of Rem Koolhaas that, “a city is a plane of tarmac with some red hot spots of intensity”.
proliferative_canvas

Building sense augmented and navigated by handheld devices “augmented_place”

small, specific, short-term tenancies relocate to exploit synergies of proximity - activity ecologies

no lease - pay by week
lease and titles swaps with no overhead - encourage relocation

Hyper-specific related activities congregate adjacent to one another

proliferate from here “proliferation”

transport & services side
activity ecology side

surface tracking
transport directly connects all activities transport_services
Volute Counterfactual

An architectural counterfactual asks how the city might be, should an existing constraint be removed. Volute imagines that vertical circulation might move freely in two dimensions on the outside of a building. Alternative kinds of typologies become possible, each with radically different properties of dendritic connectivity. New synergies occur between adjacent activities. Here at 20 Fenchurch, extensible surface, Schoen’s unnamed twelve, becomes an armature for fusing agglomerations of activities and events. Each node of activity exerts a trophic influence on its neighbour, and an architectural equilibrium is reached that exists somewhere between the flickering of lives and the staidness of buildings.

Phones profile our interests and desires by knowing our movements, communications, research and purchases. GPS and place recognition give access to stored proximal spatial information. We are alert, as we are now by our eyes and ears, when items and activities of interest enter our spatiotemporal field.
Centre for Ideas
VICTORIAN COLLEGE OF THE ARTS

CfI, 2003, West Facade, photo: Derek Swalwell
A plane is perforated by a series of holes. The holes may be distributed randomly. Dust accumulates, breeding. Soon some dust starts to flow through the holes. Beds of particles gathered in this way are only partially stable. At their edges, some will fall away until the edge reaches a certain constant critical angle to the vertical. As the dust accumulates, its edge surrounding each hole will be conical, with an angle corresponding to the critical angle for that kind of particle. After some time, the cones around each hole intersect with one other. When all the cones have fully intersected, it is no longer possible for the plane to accumulate any more dust, as all new deposits will immediately tumble towards its hole. Which hole will a given particle of dust fall through? It will fall through that hole closest to where it lands. So the boundary of each cone, defined by its intersections with its neighbours, defines an area of the plane which is closer to the hole at that cone’s centre than any other.

The Voronoi tessellation is named after Georgy Fedoseevich Voronoy who, in 1907, formally described a division of metric space into regions that are closest to a set of features on that space. Our accumulating dust cones constitute an algorithm, a process that can be used to establish the Voronoi tessellation of a plane. In this case it is an algorithm that uses the physical properties of matter (the coherence or adherence of dust) to make a calculation.

We have some intuitive familiarity with Voronoi tessellations. They are found in natural phenomena: the cracking of dried mud, ice crystals, zinc galvanising and so on. We know them indirectly from the fluctuations of cell phone signals or our interactions with distributed elements within cities such as fast-food chain outlets. Their more instrumental applications are myriad. They might be used to calculate the optimal location for new services within a city to maximise catchment. The pioneering epidemiologist John Snow, in his map of 1855, used a version of a Voronoi diagram to localise a cholera outbreak to a particular London water pump. Computers use underlying Voronoi sorting to search spatial databases efficiently.

1 It is of interest to note that the computing algorithms required to make a similar computation are non-trivial: efficient algorithms, for example Fortune’s algorithm, are relatively complex.

Jonothan Callan, cement dust sculpture

CfI, Plexus space, photo: Peter Bennetts

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CfI, early studies

Jonathan Callan, cement dust sculpture
Architects are sometimes fast and loose with the term space. Often it is used with reverential emphasis as a way to not talk in detail about the formal qualities of a building. Instead one can talk of a charged or aura-like quality generated in some unspecified way by the building. If pressed, some version of a Cartesian grid might be called up, describing an invisible but regular and oriented inscription that architectural elements locate themselves against. Certainly the influence of Mies is important in reinforcing this kind of description. Another more recent influence is the underlying XYZ coordinate system of most CAD applications.

For the sake of this discussion I wish to characterise the Cartesian grid as being constituent of a particular design domain. In accepting the Cartesian description as axiomatic, certain kinds of operations, relationships and transformations will thereby make immediate sense. The Centre for Ideas project explores a different design domain, one conditioned by the logic and relationships implicit in the Voronoi division of space. If Cartesian grids allow building elements to exist in serene autonomy, unknowing of one another and free to be exquisitely arranged by the high hand of the architect, Voronoi tessellations are much more messy. Moving an element shifts and jars all adjacent elements, pushing back at attempts to establish higher order, and curtailing the architects transcendental scope.
If the Voronoi tessellation conditioned the set of operations that comprised the CfI’s design domain, then a credible traversal of that domain was required to establish a buildable instance within the architectural realm. Early studies for the project used a random placements of points to generate the tessellation. As the design developed, points became aligned vertically to establish some more regular horizontal lines. The density of points was modulated. Lines and points became correlated to windows, floor levels and adjacent buildings. Hierarchies emerged where parts of the building were emphasised over others. The stochastic nature of early facade studies gave way to those that were almost figural. Transitions to adjacent buildings were considered, with the north facade transitioning from more normative (if de-scaling) horizontal windows, and the south having to manage a direct abutment to a particularly undistinguished existing building. Material and detail choices were made.

Any number of successful traversals of the Voronoi domain are possible. Many different buildings could have made sense within the set of operations implied by this method of establishing a tessellation. A design domain, by dint of its own internal content and structuring operations, has the ability to form sense connections with concepts and entities from a wider cultural space. Mathematicians use the term injection to describe mappings from one domain onto another. A traversal inevitably brings forward some of these resonances and allows others to recede.

A comparison with the Kanno Museum of Art in Shiogama, 2006, by Hitoshi Abe might be instructive. The Kanno museum uses a similar Voronoi structured design space, but a 3 dimensional version. Generating points are located in three dimensional space, and the Voronoi regions are convex polyhedral cells filling the interior of the building. The Kanno museum houses a private art collection. Each piece of art is placed at one of the notionally generating points within the interior - thereby creating a voronoidal spatial correspondence between the works and the surfaces of the interior. (Were it not for this, the configuration of the interior surfaces might seem largely wilful.) The exterior of the museum is by contrast a regular rectangular prism, materially anchored in rusted steel expressing very little of its internal geometry.
Seven Pillars
TAUT HYPOSTYLE

Seven Pillars, 2003-4
Seven pillars is an un-constructed project whose brief was to roof an existing
courtyard between existing buildings at Deakin University Melbourne.
In its themes and generators it is a transitional work located between the
Centre for Ideas and the Energised surfaces projects.

The design domain is structured by a variation of the Voronoi tessellation,
whereby the defining feature of a region lies at the geometric centroid (centre
of balance) of the voronoi tile. Formally it results in a more regular spatial
division. The centroidal Voronoi is found by Lloyd’s algorithm1, where
points from an initial distribution are iteratively moved to the centroid of
the region of their closest space.

The courtyard could have been clear spanned, but we were interested in
a solution that more actively participated at ground level. The structural
solution involved a series of lightweight columns guyed back to the
surrounding buildings. Each column supported a ring beam following the
boundary of the Voronoi cell. The beam was tensioned like a bicycle rim on
a series of spokes. A minimal surface membrane structure was stretched
between each beam and the column base. It was the need to balance the load
of the beam that made it necessary for the column to be located at the centre
of balance of the Voronoi cell. Light was admitted through fissures between
each cell.

We were pleased by the resemblance between our early sketches and the
hypostyle hall in Roy Grounds’ National Museum of Victoria. At that point
we were shy of tensile structures, given the fairly abject sub-Otto examples
sheltering rest stops and the like. The Grounds connection gave us a template
for development of the design that took us back to a more architectural set
of concerns.

1 Qiang Du, Maria Emelianenko, and Lili Ju, “Convergence of the Lloyd
Algorithm for Computing Centroidal Voronoi Tessellations,” SIAM Journal on Numerical
Seven Pillars, section

Seven Pillars, plan

LEGEND

1. PLINTH
2. MAST
3. INFILL GLAZING
4. UPPER BALE RING
5. MIDDLE BALE RING
6. LOWER BALE RING
7. UPPER TENSILE MEMBRANE
8. LOWER TENSILE MEMBRANE
9. ACCESS STAIR

Refer Engineer’s drawings for details and structural details.
Australian Wildlife Health Centre

HEALESVILLE SANCTUARY

AWHC, 2004-6, overview from West, photo: Peter Bennetts
In our work we find it useful to explicitly consider design techniques, as it is around techniques that the other stuff of architecture organises itself. Design techniques establish a domain of possibility in which a building comes to be, and be apprehended.

A technique can be understood as something that defines the properties of elements, their qualities and the relations they can enter into. These elements need not be material things, but, to make sense in an architectural context, they must be able to have a material instantiation.

A building can be understood as one of many possibilities consistent within a given design domain (think of the vast populace of the Miesian domain). Many of the significant architectural values of a project come about through specific decisions made within the parameters of the design space - decisions about composition, materials and so on establish emphasis and value.

The Costa surface is a “complete minimal embeddable surface of finite topology”. It is an element that has the smallest surface area for its constraints, could continue without boundary and does not intersect itself. Until this surface was discovered by Celso Costa in 1982, it was conjectured that the only surfaces with these properties were the plane, the helicoid and the catenoid. The Costa surface was initially discovered by using methodologies of experimental mathematics, whereby computers are used to investigate a large number of cases within a particular problem space prior to deriving formal proofs. It was not until 1996 that a parametric equation was discovered that could strictly specify the surface shape.

The Costa surface is difficult to comprehend at first sight. The patterns of connection within its surface, and the spatial flows and partitions it creates are somewhat confounding. Rather than make way for it in my geometric ontology, my first inclination was to dismiss it as an impossible object akin to Eschers staircase. After convincing myself it could exist, finding a place for it to reside in the architectural ontology was also a challenge. There are architectural instances of its sibling surface, the catenoid, which offered some clues. The catenoid is an efficient shape for cooling towers, some of Gaudi’s surfaces of revolution use the shape, Leonidov used them in some projects, and Shukov built several remarkable catenoidal towers.
Cellular automata patterning of block-work walls; two trials with alternate rule settings

AWHC, developed elevation
The Russians may have been interested in making a break from historic forms, but the catenoid and Costa surface also have strong radial symmetry, something it shares with domes among other more normative architectural objects. Finally, it being a minimal surface allows it to be constructed using a membrane stretched between three straightforward ring beams.

The AWHC is a working animal hospital, with an interpretive program inserted. Visitors to the sanctuary needed to see and have explained all the internal workings of the centre. We thought of the building as being a regular hospital, but prised open to enable a new interpretive organ to be inserted. The openings of the Costa surface had a ventricular quality which enabled us to think of it as having an anatomical quality without a direct mimetic derivation. The confounding sectional qualities of the surface leads to an engaging ambiguity within the internal space as to whether it is enclosed or open to the exterior. The radial symmetry of the ring structure and the billowing layers of the roof were maintained as dome like - a connection reinforced by the choice of a gold coloured membrane material over the more usual purist white. It is, perhaps, a new kind of dome under which to celebrate the contemporary secular theology of environmental consciousness.
The expression of the building’s facade had another derivation, one still concerned with computational structures and generative processes, but focusing on how information might acquire a complex ordering across a surface. A cellular automaton is a collection of nodes which can possess different states, arranged on a grid. The collection evolves through a number of discrete time steps according to a set of rules where each node derives its state based on the states of neighbouring cells. Cellular automata were first studied in the early 1950s in John Conway’s Game of Life, and have since been suggested as models for biological and other complex systems. Studies of emergence, which investigate how high level phenomenon can come to be through the action of simple low level rules, often use cellular automata as a canonical example.
The paradigmatic set of cellular automata rules in Conway’s Game of Life lead an initial random state to converge to a regular but dynamic and so continually changing pattern. It is not necessary, however, that emergent phenomena be dynamic. The set of rules used at the AWHC are from a formulation proposed by Wolfram1 and yields a state that uses a weighted sum of the regions surrounding a given cell. The pattern of weighting is controllable by parameters which may vary across the grid. This set of rules always converges to a stable static pattern, which is interpreted in the building as a masonry set-out for the building’s façade. The parameters controlling the pattern are made responsive to building and programmatic elements. The character of the patterning at any given point of the building skin varies according to distance relationships to other building elements.

This patterning has some zoomorphic qualities. In fact, Wolfram proposes this particular rules system as a mechanism underlying the patination of animals, where such a mechanism is placed under evolutionary control to produce a pattern bestowing a survival advantage. Here the mechanism is redeployed to more architectural ends, shifting the pattern in response to the internal and external organisation of the building. While the zoomorphic nature of the pattern is embraced to serve the representational needs of the building, the organic entity it participates as part of is the building itself.

If the informational content of the arrangement of the block-work enables a relation to living systems, its tectonic qualities also establish a valency with other architecture. Melbourne’s Victorian era building stock contains rich examples of polychromatic brickwork, which has been returned to by various architects, notably in Peter Corrigan’s work. The AWHC also takes part in that conversation.

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Section of dome of St Paul’s Cathedral, 1668-77, Sir Christopher Wren
Cloudnets
THE FORCES BEARING ON SITES, AND THEIR INTERSECTIONS

Cloudnets, overview, 2008
'Imagine a very large town, at the centre of a fertile plain which is crossed by no navigable river. Throughout the plain the soil is capable of cultivation, and is of the same fertility. Far from the town, the plain turns into an uncultivated wilderness which cuts off all communication between this state and the outside world. There are no other towns on the plain. The central town must therefore supply the rural areas with all goods, and the town, in return will obtain all its provisions from the surrounding countryside.'

Johann von Thunen ‘The Isolated State’ 1826

Cities are complex, emergent entities. That is, their large-scale phenomenal qualities derive from a myriad series of small scale rational decisions made at the level of individual sites. These small scale decisions attempt to find the ‘highest and best expression’ for that particular site. Each site is conditioned by its relationship to the form and use of all other aspects of the city. For example, to transport infrastructure, the size of its neighbours, its proximity to retail and places of work. Cities develop iteratively. As each site finds its best use at a given moment, it changes the potential value of other sites, enabling them in turn to be transformed in use and form.

Architects intuitively understand that every site, which is a particular location for a building, possesses a potential value quite specific for that site. Further, certain uses realise more value than others. This value related to location and use is fundamental in shaping the building, for the building responds to this field of forces determining potential value to realise and return an actual return. A given building channels potential values, represents and makes them material.

The beautiful premise proposed by von Thunen led to the first clear formalisation of spatial value. He related the yield of crops, their market price and transportation costs to the value of land. What followed was a distribution of different crops being grown in concentric bands around a city. Certain crops make sense within a particular radial zone: further away transport costs render them unprofitable, and closer in other crops are more profitable. Von Thunen discussed agricultural production, and was working prior to the industrial revolution, but the extension of his model to account for a significant component of land values within cities is straightforward.
The field of urban economics extends von Thunen’s insights to describe many aspects of the spatial economy of cities. Paul Krugman’s Nobel prize winning work described aspects of how production is organised spatially in a globalised economy¹. An important component of his work emphasises the value that derives from a preference for diversity and choice of inputs into a production process. For example, the availability of competitive supply of component parts and an educated and experienced workforce will be important factors in locating a manufacturing business. A preference for diversity is an important factor in the city of consumption. People balance a preference to locate themselves close to high value employment opportunities with a rich diversity of consumption: affordable access to services, products, entertainment, physical environments and so on.

It is clear that these kind of factors are drivers for the movement of people from rural to metropolitan areas. Doug Saunders in his book Arrival City² describes the improvements in health and wealth that follow. He also describes how cities consume fewer natural resources per capita than rural populations. These same drivers lead to an increasing complexity within cities. The diversity of goods, services and production inputs relate together to create an increasingly complex matrix of potential values. The field of urban economics contains important insights about how cities are organised and structured. Concepts such as congestion modelling, search costs, production inputs and land value as an expression of travel times all say important general things about the potentials inherent in the spatial arrangements of a city.

² Doug Saunders, Arrival City: the final migration and our next world (Crows Nest N.S.W.: Allen & Unwin, 2010).
If spatial economics describes the potentials of value and possible uses at general locations, CloudNets attempts to capture these insights in their specifics at a more local scale. A city can be modelled at a specific level as a series of nodes, connected spatially to other nodes. To determine the state of any particular node, the condition of other nodes can be examined and responded to. As changes to a node affect its neighbours, this response is repeated iteratively. The importance of the state of adjacent nodes is weighted in various ways based on proximity. Aggregate properties of all the nodes can be determined and so used to, for example, optimise for particular overall properties. Over a number of generations, the system may converge on a stable state, or, more often, will continue to change developing increasing levels of local complexity.

This underlying methodological structure draws on techniques used in earlier projects. Specifically it is a generalisation of the cellular automata work such that it operates not with a gridded pattern of connectivity but across a topologically determined general graph. CloudNets mashes up disparate technologies - network graphs, cellular automata, and some parametric constructors - to construct a workbench that vividly reveals the operative relationships of our everyday cities.

This mode of investigation disregards many aspects of real cities that are often the subject of architectural examinations of urban effects. For example issue such as specific topography, historic patterns of existing development, existing cadastral boundaries and the complexities of local political events affecting development potential are de-emphasised. Instead it looks for emergent patterns and dynamics in cities, and attempts to understand the forces driving these dynamics. By looking at these issues at the scale of individual building sites, it provides a more exact understanding of what architects intuitively understand as site potentials. A clearer appreciation of which can help clarify the kinds of operations used to realise these potentials as buildings.

At base economics studies the aggregate accumulation of the myriad small decisions individuals make to make the best of their particular momentary circumstances. They are decisions that represent current conditions, but contain a best guess at what the future might hold. Buildings exist somewhere between the action of an individual, and the aggregate forces that shape the economic world. On one level, the decision to build buildings reflects a collective confidence in the continuing stability and future potential of a particular location. CloudNets makes this intermediate scale of action available to architectural operations.

Antecedents

TOPOLOGY AND TILING

If these projects belong to the same area of concerns and range of methodology, it was a trajectory that began in 1993 with my undergraduate major project, Out of The Bottle (1993). That project unpacked a fascination with the parallels between architectural and mathematical ideas, and particularly how innovations in geometry tracked formal shifts in architecture, certainly until the Baroque period. It then speculated on how the more recent extension of geometry into topology could transform certain architectural concepts. This project also saw the first appearance of the Costa surface that was ultimately constructed in the AWHC project.

During this period I was working in the offices of the Melbourne practice, Ashton Raggatt McDougall, who had recently completed a series of projects that wrangled with the notion of identity in Australian architecture. It was a braid of concerns common to a broader cultural drive to define an Australian cultural identity that gathered momentum with the Whitlam government of the mid-seventies. Peter Corrigan was the Melbourne architect most vividly associated with the beginning of this period. If his work expressed a robust and larrikin joy sourced from a vernacular Australian culture, ARM carried the project forward in a more selfconscious and post-modern way.

Employing strategies of (mis)appropriation, multiple direct reference and imperfect transmission, their work appropriated rarefied artefacts of the architectural canon, nearly all of which was located in the northen hemisphere, and which had arrived via a secondhand discourse emanating from the centres of cultural power (of which Australia could never expect to be one). The ARM work of that period was concerned with questions of how a vital architectural culture could exist away from the defining centres of culture; how could we make work which was not merely a pale imitation of the northern canon, legitimating itself through a received, excessively


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Storey Hall RMIT University, 1996, Ashton Raggatt McDougall

Copyrighted material omitted
revered and misunderstood version of the northern discourse.

I worked on the design team for the Storey Hall project, with Howard Raggatt as director in 1992. It marked a shift in their work in that it included elements concerned with computation and mathematical ordering. The Penrose aperiodic tiling was an important component of the building, a pattern that had been purloined from a Martin Gardener Scientific American column from the mid seventies. The tiling seemed a counter-intuitive and magical thing: how could a simple pair of regular elements cover a surface in a way which doesn’t ever repeat?

These kind of design spaces are now more familiar. One notable example is Lab’s Federation square project in Melbourne, which uses another aperiodic tiling on it’s facade. Lab’s traversal and intentions, however, are markedly different from those of ARM at Storey Hall.

Immediately prior to leaving to start Minifie Nixon Architects, I worked on the National Museum project in Canberra, again with Raggatt as director. I was involved in designing the complex, continually curved knotted geometries throughout the project.

Raggatt continues to be interested in a radical questioning the ability of Architecture to convey meaning, to the extent that it can be understood as an architecture of deliberate overreach. For if it fails to be convincing, then the locus of ultimate coherence cannot lie within a building, or by extension, in any other worldly cultural expression; it must lie therefore in an entirely other, perhaps unworldly, realm. While I continue to share many of Raggatt’s commitments to an Architecture that can speak broadly, beyond itself, we differ in that I would hold that any sense that can be made can only be with respect to the world as we live it.

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2 Works of this period include: the Brunswick Community Health Centre, the William Angliss Nursing Home, the Howard Kronberg Medical Clinic, the Australian Council of Educational Research (unbuilt), and its later reworking as the Australian Institute of Aboriginal and Torres Strait Islander Studies. A discussion of some of these projects can be found in Ian McDougall’s Masters by Project thesis, The Autistic Ogler; Leon van Schaik (ed.), Transfiguring the Ordinary, ISBN 0646210548 (Melbourne: 38 South, 1995).
Commentaries

SHANE MURRAY

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Shane Murray is the Foundation Professor and Head of the Department of Architecture within the Faculty of Art & Design at Monash University. He is considered an authority in the discipline of architectural design and has published and lectured extensively in this subject. His research interests include architectural design and contemporary housing.
In his review of the Centre for Ideas in Architecture Australia, Murray suggests that the emphasis we placed on the Voronoi tessellation is primarily a means of seeking legitimation and authority from a location external to the discipline of architecture:

In describing this transmission of concept, Paul Minifie observes that the diagram has been sufficiently maintained in its transmission through to execution that it suspends other acculturated readings. These other readings might have included the role and history of facadism in Melbourne architecture, among many. It is interesting to speculate as to why Minifie seeks this direct transmission of concept. I suspect it emanates from the belief, which is not unique to him, that this is currently the only acceptable path for legitimacy in contemporary architecture.¹

In his PhD dissertation, he proposes that such explanations throw little light on what we as architects actually do. Furthermore, Murray develops an argument that the architect, through engagement with disciplinary knowledge and the act of making, develops a language and mode of composition that forms an integral base of action that can be deployed in response to particular design circumstances:

My observations reveal that when examples of architectural execution are examined, what emerge are quite different from precedents and explanations for their physical outcome that their accompanying discourses claim, In disclosing these influences much architectural execution relies on compositional procedures that have direct historical precedent with the history of architectural composition but that these are rarely, if ever, disclosed.²

I share with Murray a concern with issues of architectural making, and the provision of an account for the identifiable qualities and attributes of a particular building. He proposes a model where the procurement of disciplinary knowledge occurs through accumulated experience of doing, and is further seeded by precedent emphasised as being already internal to architecture. Ultimately this disciplinary knowledge becomes an applicable language with an accompanying set of consistent compositional rules. While this model does provide for a legibility and consistency across the work of

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different architects and building types, it seems unable to provide a full account of transformation and change.

As an (admittedly caricatured) example we have seen how a design domain established by Mies and other moderns continues to exert a strong influence on architectural practice. It seems to me that the clarity and flexibility of the compositional devices it is invested with enable a huge range of conforming outcomes that can differ in inflection but still remain as valid expressions of that domain. The effect is an almost meme-like transmission through the vector of taste from architect to architect, and publisher to client. Continuity needs no legitimation. Its unquestionably constituent place in the genetics of architectural practice and continuing pragmatic efficacy ensures its survival. In a model that emphasises internal continuities and literate modulations, and as only minor and cyclical inflections are required to satisfy demands of fashion, architecture might continue in this domain indefinitely. Let’s texture that floating wall with a nice ply this time. Onyx is a bit yesterday.

A spatial partitioning structured by features in a space does constitute a domain where a different set of operations and organisational relationships make sense. Traversing this kind of domain is still an act of composition that needs to satisfy a set of building requirements and so architectural themes consistent across domains. A given traversal involves choices of expressive emphasis that brings forward or makes recede mappings to a similar set of architectural disciplinary concerns.

Structures such as the Voronoi tessellation are already present in multiple disciplinary areas, not because they provide legitimisation, but because of their utility in description, prediction or organisation. Historically architecture has hardly been immune to borrowings. It is difficult to imagine that Mies was as oblivious to a sheet of graph paper as he was mindful of Schinkel. Whether a novel design domain is successful in architectural practice depends ultimately on its practical utility and ability to transform practice; to both provide new insights whilst addressing anew existing

3 Timothy Love suggests Hejduk’s pedagogical use of the nine-square exercise, and his own elaboration of it in his “Texas” houses, established, “…for the first time in the academy a self-conscious rather than a casual acknowledgement of a prevalent Modernist canon [with a bias towards Miesian language] within the structure of a design curriculum... The systematic representation of pre-existing architectural languages is consistent with the role that the analysis of historical precedent played in the new curriculum at the University of Texas. The implication was that architecture was a language to learn”. Timothy Love, “Kit-of-Parts Conceptualism, Abstracting Architecture in the American Academy,” Harvard Design Magazine, 2003, 3.
architectural problems and themes.

An architectural discourse, be it conservative or transformative, might indeed make accessible an argument for a particular mode of architectural practice. I’m in accord with Murray in identifying as a key issue whether such an account might also provide a plausible and instrumental account of how a practice of making relates to the specific attributes of a building.
Dr Pia Ednie-Brown is an Associate Professor in the RMIT University Architecture program and a research stream leader at SIAL, teaching design and theory, and supervising Masters and PhD candidates. She has a research practice, Onomatopoeia, involving art-architecture installations, animation, sculpture, creative writing and theoretical analysis. Her 2007 PhD dissertation, “The Aesthetics of Emergence” draw on the work of this practice, while utilising radical empiricist frameworks to generate a new model of composition related to contemporary design process and its relations with emergence theory, aesthetics, ethics, embodiment and affect.
Pia Ednie-Brown, in her PhD dissertation, discusses the Streaming House in the context of the capturing of movement within architectural form, and how this might relate to broader concepts of vitality and emergence. She compares it to Mark Goulthorpe’s Ether 1 project and Greg Lynn’s discussion of animate form. She writes:

…it burrows into perspectival depth-in-movement such that it is radically flattened before acquiring an entirely new depth. The nature of that depth? You can turn around to see the edges of all you saw still there, relentlessly stacked up and skinned behind your back. Certainly this project operates almost surgically, on the construction of visual perception and the Cartesian model of form and space, twisting and grafting them together in such a way that, at least potentially, enacts a perceptual, conceptual and experiential twist. This topological reconfiguration of constructs of experience might be argued to be one clever technique through which to twist the animate into form, but it certainly is not the technique that Lynn promotes.¹

While in relation to the apprehension of the work by an observer, she comments:

In both the Ether 1 and the Streaming House examples the nature of the objects themselves do encourage the sense of some kind of active past or forceful event that generated them. In no way do they necessarily point back to the particular process through which they formed, but only to a general sense of something having happened. If approached with no knowledge of the generative technique, it would take a miraculous act of code breaking to back-track the sequence of moves that led to the Streaming House’.²

One way an author might respond to commentary on his work is to comment on whether the perspective offered is constructive in defining criteria for the success of such work.

The question of whether a viewer apprehending the work is able to reconstruct its process of becoming does seem an important test of a project. Certainly we see many ‘process driven’ projects which loose the possibility of any reconstruction. To borrow a concept from mathematics, there is no unique

²  Ibid., 147.
mapping between the elements from the initial domain onto the finished object, rendering the science of process as something between inexact and impressionistic. I would consider at least the possibility of reconstructing the actions constituting a project, even if it does take a ‘miraculous act of code breaking’, to be an important component of a project’s rigor. In fact, the act of decryption involved here may be unfamiliar but it is not difficult – any radial section through the Streaming House yields a line drawing of the Barcelona pavilion perfectly Miesian in its concision.

Ednie-Brown’s broader proposition of vitality as a transcendental life-quality that can be possessed by certain designed objects, at least at an aesthetic level, is an intriguing one. I share the interest in the kinds of organising systems where relatively simple and straightforward seeming elements and relationships yield complex and unexpected outcomes that seem to have a qualitatively different phenomenal nature. These kind of events seem significant to me more because they point to failures of our usual methods of comprehension to understand aspects of the world. It is a common impulse of the human animal to phrase a failure to understand something in terms of a mysterious transcendental quality. And indeed this space is one of the pivots of architecture, and one of the subjects of investigation of these projects.
Conversation

PAUL MINIFIE WITH REBECCA ROKE

Rebecca Roke is an architect and is currently an editor at Phaidon Press. She conducted this interview for the purposes of her Masters of Architecture thesis (undertaken at RMIT University) entitled “Bits and Pieces, Crafting Design in a Post-Digital Age”, which investigates possible shared relationships between digitally informed technologies and processes for design and crafted approaches. She has lead design studios in the School of Architecture at RMIT and formed the collaborative studio Maunu, who examine potentials for hand-and-computer-generated design.
At the turn of the century, there was much enthusiasm and optimism around the possibilities offered to architecture by the digital tools. What would you say some of its immediate impacts were?

During the nascent use of digital mediums in architecture there was a lot of digital work that I didn’t like very much because the discussion was always about liquid space or about some impressionistic, mediated environment. There was a popular response to the look of most designs and transparency was a classic approach that’s seen in so many designs of that mid-nineties era. Many buildings were represented as large volumes that sat against black backgrounds as sort of disembodied, transparent objects with slightly blurred effects. That work is terrific but primarily it engages at the level of the image; it is about the quality of the image on the screen. Of course, as with all popular new approaches, the image quickly became a cliché but it was still a strong mode of representation. The relationship between particular technological changes and changing modes of representation is a story that’s well told. One of the problems with this established relationship in early applications of digital tools is that the main deliberation for most theoretical architectural critique seemed only to discuss the new qualities of representation.

The question of representation also underpins another aspect of what were then new digital methods of design. If you drew a sketch of a double-curved surface by hand it was difficult to test whether it could actually exist as a three-dimensional object. Traditional perspective drawings appear to offer a certain guarantee that is inherently architectural. If you draw a view with square edges that follows rectilinear logic within a perspective space it looks convincing and seems to indicate that what is drawn is inherently architectural; it could be constructed and it could exist in physical reality. Though you could produce double-curved surfaces – surfaces that were randomly curved – at that time by hand, one of the reasons why curvy types of architecture didn’t really happen until the computer became prevalent was that no-one really trusted those hand-produced representations. There were double-curved examples that pre-dated computerised images but generally people didn’t have the skills to understand how the representations could be thought of as architecture. One of the interesting things that the computer is able to do is analyse formal possibilities of an object. By its very nature, with the computer you can have an object on the screen, turn it around, look at it from different perspectives and understand it better as an architectural form.

A related problem of the bloated curvaceous work of that particular era was the enormous amount of effort you had to undergo to construct a project.
The effort to represent it, to make the shape, to get it built, the material usage – all these types of concerns made it a very inelegant endeavour. The relationship between the idea and the materialisation required such effort that it seemed to fail the elegance test; it involved so much unnecessary work to get there. The idea of having to CAD/CAM out some crazy double-curved form, which was then sprayed with something else to make it work, seemed a terribly inelegant solution. Appropriately, another obsession that appeared in early examples of digital form making was connected to the development of people’s increasing expectations of what you might do with digital architecture. There was a fanciful idea of the universal fabricator where you’d press print and instead of an image appearing on a piece of paper any kind of building would manifest. In my opinion, that seemed to kill one of the constitutively good things about architecture, which is to do with trying to find other relationships between materials, thought and form, and numerous other architectural considerations. If you could make any building you wanted there was no longer any tension between those difficult choices and the architecture would just turn into some sort of fantasyland object.

RR So you evidently had misgivings about the more glib aspirations gathering around the digital; where did you decipher a more constructive or compelling relationship to architectural production. 

I was interested in a divergent idea where you would find some kind of unity between construction logic, materials and technical expression. Certainly part of the idea of achieving unity is related to the methods by which you design. This relationship is a sometimes suppressed one because there are generally stable techniques by which you achieve things in architecture. There are established modes of representation and techniques for representing space and materials and construction methods. It seemed to me that you could keep the general conception of what architecture is 1

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1 This concern, referred to in the previous paragraph as being with the elegance or inelegance of an endeavour, is probably what lies behind what some have identified as the generational resolution of the CfI project. As Leon van Schaik notes, it “...demonstrates a built accomplishment that eludes most ‘blob’architecture. Where others grope towards appropriate ‘nonstandard’ constructional form, [the practice’s] years of working on the corruption of standard software programs and their mathematical nous have enabled them to produce a building that is fully resolved in the terms of its generation as a design. Others who have imported a technology from another domain struggle to find an expression for the resultant forms within normal and affordable construction-industry procedures.”Leon van Schaik, Mastering Architecture: Becoming a Creative Innovator in Practice, 1st ed. (Academy Press, 2005), 28.
and radically rethink a part of it. One of the parts that seemed interesting to examine was how – through what techniques – we actually design. Consequently, an area to consider was the techniques that a computer uses and whether these could be applied to architectural intent.

My response to implications of the computer in architecture could be read as a reaction against the problems of representation and inelegant solutions. However, I was primarily interested in examining different opportunities that relate to how a computer actually works. A computer processes things in a fabulously rigorous way: it can only follow the directions you instruct it to do and you can’t distort the process easily. One of the nice things about the way computers operate is that the same techniques keep reappearing in very different problems. The computer is also inherently describing spatial matters – even when it’s just processing a small computational thing, it is always dealing with a sense of space – whether it’s the electronic space of data or GIS (Geographic Information Systems) description or an object or something else. With the curvy representations that people were creating, the designs had qualities that were about trying to relate to the aesthetics of the image. However, the tools of computer processes that were available to generate this work were just being used to draw the new shapes. Again, some of these formal choices were interesting but they shared a problem that was co-existent with issues of representation. With a double-curved surface there is no easy way of judging what is good or poor; essentially all those volumes are the same.

A specific geometric example that illustrates the gap between what was predominant and what was possible can be seen in the difference between how you might read a NURB (non-uniform rational b-spline) surface and a polygon surface. The two surfaces look more or less the same at a formal level but they’re structurally distinct and perform in very different ways. NURBS are truly curved surfaces no matter how close you examine them whereas the inherent triangular structure of the polygon surface becomes faceted as you zoom closer in. In other words, although the surfaces look similar they are fundamentally different in terms of the set of tools they are constructed with and how you can then operate on them. It was the rigorous examination of possible techniques for architecture that I was interested in.

When you consider the computerised process in architecture in this way it becomes apparent that there are many continuities between architectural thinking and computational and mathematical logic: geometry is a classic example. If you read architecture with a bias that emphasises its relationship to geometry, you can argue that there are fundamental constituent ideas that are shared between geometry and architecture. A simple application
of this idea is the concept of the Cartesian x-y-z grid that is so obviously fundamental to Mies van der Rohe’s work. It allowed him to work between the conceptual realm and the material realm efficiently. You could also argue that the practical and everyday application of Cartesian geometry was potentially recognisable for most people and that this is one of the sources of power in Mies’ work.

A similar argument can be drawn when applying another specific technique, such as a tessellation. This discrete diagram has solved many problems, such as the placement of cell phone towers or where you’d locate the next 7-11 store in a city, because it can be used to analyse and solve questions of adjacencies. I would say that we intrinsically understand that sort of contingent spatial relationship, partly because it is present in primary physical experiences, such as how mud cracks. It is also related to the amount of technology in our lives. In other words, there’s a kind of recognition of the diagram at an inherent functional level – I hesitate to say it’s a metaphysical level – that being able to operate in contemporary life automatically requires you to engage with an essential level of technology.

RR How would you describe the techne trouve? It seems to be derived from the idea of the objet trouve, conjoined with the idea of techne. Why is it a useful descriptor in your practice of architecture? How did you come to discover and implement it in your work?

The use of techne trouve (the found technique) intersects with this idea, such that you can conjoin the found technique, like a tessellation, with an architectural consideration and engage the techne trouve at a different level. One of the important properties for this appropriation to work is that, in some way, the technique that you’re using must actually be functional in some sense. It’s not applying an impressionistic, representational description but it must actually be present in its use. The analysis of use in adopting techne trouve relies upon three central characteristics: functionality, the space to consider details and ‘designed space’.

The first property is quite evident. If the technique is functional you are able to make a move and have other things change in a formally consistent manner. For example, if you shift one part of a structure, other parts will move in a predictable and recognisable way because they are related by a set of functional formal relationships.

Second, one of the ways of designing with techne trouve is to think about how to deal with architectural material such that the technique reveals itself in
the most telling way and this can be considered as the space to think about details. To revisit the example of Mies’ work, the cruciform is a very direct example where you can see the regular treatment and consistent reference to the grid. You can also read details such as they way he treats corners and you consistently find that the work engages with how to reveal the underlying conceptual trope of the Cartesian grid. The question of the geometric condition for Mies’ architecture was how to reveal the Cartesian concept in the clearest possible sense, though of course, this is a very partisan and deliberately skewed view of Mies’ work.

The third characteristic is designed space. This simply recognises that most found techniques could enable a hyper-astronomical array of possible things that could exist and still be consistent with that technique – they’re like a family of properties. That is, for each particular form or data structure there is only a defined number of things you can do with it and this clearly relates to the earlier discussion about how a computer operates, too. Each technique only has a certain number of uses and if you want to do something else you need to find a different tool. Not only that, the tools of one technique may not necessarily be compatible with another; one tool can’t necessarily just map elegantly onto another because you can destroy the fundamental capability of each.

This tripartite way of engaging with techne trouve then introduces several questions about how to use such a technique. One advantage is that having established the criteria you can then consider the question of conflict and unity in architectural composition again. Nevertheless, when there’s a vast amount of information to interpret and use, which techne trouve do you choose? Most often the selection requires observing what constitutes a particular technique and what its spatial possibilities offer.

My sense of organic unity also includes reference to a certain amount of the immediate cultural context and I see no reason why this can’t be compatible with technique or abstraction or similar considerations. The ‘family’ of tensile structures that are referenced in the gold Costa surface of the Australian Wildlife Health Centre (AWHC) have a certain abject quality, like petrol station canopies or tedious shade structures. They seemed so irredeemably beyond the pale and it seemed like a slightly ironic, amusing thing to try and redeem them by another approach. One of the ways we did that was by looking at the Costa surface, which is a very conservative continuation of geometry in a way, in that it engages with established ideas such as Platonic volumes. You could say that using that form in architecture is almost a straight extension of ideas of mathematical purity that are effected in a very simplistic way. It was irresistible to use it and there were
certain things involved, such as the choice of gold material, which was very important. As a consequence, it can talk about the history of a golden cupola or dome and on one level it’s just like a dome. In another way, the fact that it is not white meant that it was distinguishing itself from the rubric of Modernist purity. As a consequence it discovers an older, richer and pre-modernist relationship.

Another common yet bogus problem that occurs as people have undertaken various sorts of architectural experiments with applied digital techniques is the idea of the ‘stopping problem’. In a dynamic process that offers many similar results, why does it make sense to stop at a particular iteration? How do you choose which of the many iterations is best?

An example of how we implemented a property discovered through techne trouve can be seen in the design process of the AWHC brick wall. Though the pixel relationship of the wall maintained low-level rules of emergence, the composition was actually convergent – it stabilised at a particular configuration. That is to say, an emergent process lead to a completely stable solution and this seems to be a far more convincing way to be decisive when using an emergent relationship. Though we could still control aspects of it, it was a system that would work itself out and stabilise. This allowed us to return to more selective issues that again address the idea of unity and tension; which aspects do you choose to control?

RR To conclude then, what would you say is the the value of the techne trouve to the making of architecture?

Ultimately, the techne trouve is useful as a specifically digital variant of the ‘objet trouve’. It draws on existing data or systems for reuse in rigorous computer-based processes. This device becomes useful in architecture when it is functionally effective in evolving a new generation or series of generations of form through specific tools. With this exploration there is the opportunity and possibility by which you can discover and control a range of ways to find unity of some kind between architectural hierarchies – construction logic, materials, technical expression and so forth – in order to create elegant and efficient architectural forms.
Future work

CITIES

The Cloudnets project sketches out a realm of intermediate scale urbanism that seems promising for future research work.

The realm of action between broad planning decisions and the individual building seems increasingly pressing and problematic. There is a lack of theoretical tools that can envision large scale simultaneous developments possessing a productive complexity comparable to that which has developed over time in any established city.

Large scale flows of people and capital shaped by macro economic policy settings provide the broad drivers of new cities. But these are blind forces that have no convincing or responsive methodology for envisioning a rich and complex city form. Potential value is squandered by crude and course grained spatial decision making. The recent redevelopment of the Melbourne docklands, for example, simultaneously made available several large sites to a market who welcomed large floor plates as a way of deriving a rapid return on investment, even if it fails to maximise social amenity and fine grained economic interactions.

Developing a workbench that captures some of the behavioural economic relationships shaping cities in a manner that can drive formal building generators at the scale of individual sites would seem a promising area of future work.
BUILDINGS

The first blush seems well faded on the initial proliferation of novel computer facilitated designs. The word optimisation is being used alarmingly. Constructed projects seem less singular as they come back to grapple with the range of issues that were only temporarily put to one side. With the middle eastern bubble burst, theoretical projects that still cling to the mantle of the new become more extreme, in some cases removing the bothersome constraint of gravity as they become lost in space. Other tendencies among students reject any kind of sophisticated formal approaches, including the usual dull catharsis of authenticity in craft and materials, in favour of localised narratives of social engagement.

Where does this leave a mid-career architect who has tried to make every project anew? No matter. Fail again. Fail better.

Invent a space of actions, traverse it, chart its valencies, rinse and repeat until it is tight and strange. It seems a model for doing architecture that could go round a few more times. Without plumping for a decorous well craftedness, I can see future projects being a bit less insistent, less singular and working harder to modulate affect and association. That may help the projects adhere more convincingly to a broader set of concerns.

The aspect of these projects I am most fond of is when they discover that thing that confounds the standard cognitive model of how the world should fit together. I’d like to find more of that.
BIBLIOGRAPHY


Murray, Shane, “Design Discourse,” in Architectural Design Research: project-based design research and discourse on design, Brent Allpress and Michael Ostwald (editors), Vol 1, Issue 1, 2005


