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# Searching for Open Form

## The Pinwheel Plan in the Work of John Andrews

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*While the pinwheel plan type assumes its place within practices of twentieth century architecture, the evolution of the type has never been traced historically. For the first time, this paper will open an account of the pinwheel plan type from its emergence in Le Corbusier's spiral form projects of the 1930s to its proliferation in the international scene of the 1950s and '60s. Taken up seriously in works by James Stirling and the members of Team 10, including Alison Smithson, Piet Blom, Aldo van Eyck and Jaap Bakema, as part of search for flexible open-ended plan forms, the pinwheel plan had virtually disappeared by the mid-1970s. Drawing upon this reconstructed history of the pinwheel plan, the paper will frame the early work of eminent Australian architect, John Andrews, who adopted the plan type in a little known housing scheme for the Canadian Stelco company in 1964. Andrews' use of the pinwheel plan marks a critical moment in his creative development in which the architect turns from the use of relatively simple geometric forms in plan to the kinds of geometrically sophisticated forms that dominated his practice from the mid 1960s onwards. Analysis of Andrews' design for the Bellmere Public School (1964-65) will be used to evidence the impact of pinwheel forms on Andrews' technique of planning. Yet it is Andrews' development beyond the type during the period of the mid 1960s that would eventually mark an important legacy of the architect's work for the culture of contemporary architecture.*

The architect John Andrews is unique among Australian architects for having major impact in both his homeland and North America from the 1960s through the 1980s. After graduating from the University of Sydney in 1956, Andrews attended the Graduate School of Design at Harvard, then under the Direction of Josep Lluís Sert, taking his Master of Architecture in 1958. From



1959 to 1972 Andrews practiced largely out of Toronto, Canada, where he initially established his reputation as a leading architect through the design of Scarborough College (1963-69), a project that garnered the architect wide international acclaim. Returning to Australia in 1972 to form the practice John Andrews International, the architect continued to attract significant commissions including the King George Tower, Sydney, completed in 1976, and the Cameron Offices, Canberra, completed in 1977. Apart from the many Australian projects executed from the 1970s onwards, Andrews continued to work internationally winning the design competition for the Intelsat Headquarters, Washington, DC, in 1980, completing his work on the complex in 1988.

The architecture of John Andrews and his practice is recognised for addressing patterns of use, circulation and organisation expressed through the modulation of space arranged in intricate, geometrically ordered and gridded plans.<sup>1</sup> This paper addresses the origins of Andrews' technique of grid planning by closely examining project work in the period just prior to the design of the South Residences, University of Guelph (1965-68). Recent research by Jared Bird has shown how Andrews' geometrically based plan technique—the use of diagonal and orthogonal grids to organise relationships between rooms, clusters and circulation routes—originates with the project for Guelph, offering a critical mainstay to the work of his practice that persists in various iterations through a string of projects produced through to the mid-1980s.<sup>2</sup> The aim of the paper is to reveal critical developments in Andrews' use of plan patterns at the inception of this technique of planning in 1964-65.

Andrews' working with plans in this seminal period exhibits two conflicting tendencies. Firstly, the architect's work reveals how he is drawn to influences in the immediate context of avant-garde post-war architecture—the work of Team 10 and the Japanese Metabolists in particular. Secondly, Andrews' seeks to develop his own planning methods in relation to the specific architectural problems he faces, distinguishing his work these sources. Thus separately from, but in line with, his architectural contemporaries, Andrews' conducted his own search for open forms for his architecture—geometrically ordered plans that exhibited greater flexibility in response to change both technological and social.

Two key projects will be discussed that illustrate Andrews' preoccupation with plan forms and technique; firstly, his little known housing scheme for the Steel Company of Canada (Stelco)

1. John Andrews and Jennifer Taylor, *Architecture: A Performing Art* (Guilford: Gutterworth Press, 1982), 169.

2. Jared Bird, "Octagonals in the plans of John Andrews," in *Audience: 28th Annual Conference of the Society of Architectural Historians, Australia and New Zealand*, ed. Antony Moulis and Deborah van der Plaats, (Brisbane: SAHANZ, 2011), cd-rom.

undertaken in 1964 and, secondly, his scheme for the Bellmere Public School, Toronto begun in early 1965. Both projects feature pinwheel plans, a significant choice by the architect, which, as the paper will argue, reveals a search for open form that places Andrews' design work and thinking in close parallel with that of his contemporaries in the international context.

In March 1964, John Andrews signed an agreement with Stelco to produce a building design created from steel products for its "Trend" promotional brochure, with the company seeking the material be used in 'interesting and imaginative ways.'<sup>3</sup> Andrews proposed the use of steel for medium-rise mass-produced housing, arguing the need for dwelling to be revolutionised to match technical advancements in the fields of communications and travel. The building consisted of a vertical frame organized like a "filing cabinet," which could accept mobile prefabricated units that could be altered or replaced at will. Units could be 'traded-in' as the needs of dwellers changed or to accept more technologically advanced components. The tower is arranged with a core/stem containing vertical circulation and services around which corridor access to the apartments are arranged to form a pinwheel plan.

Andrews' approach to the apartment building proposal rests on a familiar problem—the claim that architecture lags behind engineering in harnessing the potential of technological change. In the supporting text he questions his readers accordingly: "Have we applied the same advanced technical thinking to the places in which we live as we have to the means by which we live?"<sup>4</sup> Such rhetoric extolling the virtues of technological progress applied to architecture traces back to early twentieth century mass housing prototypes such as Le Corbusier's *Maison Citrohan* (1922) and the German *Existenzminimum* programs, both from the 1920s. A sketch drawing shows Andrews' design borrowing from Le Corbusier's famous 1947 representation of the *Unité* apartment concept, where a scale model of a prefabricated dwelling unit is shown being inserted by hand into a simple structural frame.<sup>5</sup> He also draws from Le Corbusier's graphical rhetoric elsewhere in illustrating his concept in the "Trend" brochure. Specifically Andrews borrows the iconic panorama of high-rise blocks illustrating the *Plan Voisin* (1925) that shows a set of evenly spaced towers and a circling bi-plane. Andrews makes an equivalent image of towers arranged in a landscape to describe his proposal, with the bi-plane replaced by a helicopter.

3. John Andrews, et al, "The Apartment Building," *Stelco Trend Brochure* (1965). Canadian Architecture Archives, University of Calgary Library, Canada, 127A/Box 1.

4. Andrews, "The Apartment Building"

5. Le Corbusier, *Oeuvre Complète 1946-52* (Basel: Birkhäuser, 1990).



In relation to the post-war milieu Andrews' Stelco housing also exhibits parallels to Kisho Kurokawa's Metabolist projects particularly the latter's unbuilt precast concrete housing project (1962). A key concept expressed in Kurokawa's project is that of 'material metabolism'—where cycles of change and obsolescence in the components of building could be accounted for by making architecture flexible in the redundancy of its parts<sup>6</sup>—and Andrews mirrors this idea by adopting a strategy of refit and replacement for the mass-produced components of his Stelco building. There are also strong formal parallels to note. Kurokawa's earlier unbuilt precast concrete housing project features curved and modular elements forms that are strikingly similar to the arrangement of windows and balconies deployed by Andrews for the Stelco project. Other formal parallels might be found with Archigram's Plug-in-City (1964) but, as Philip Drew notes, Andrews' sensibility of approach is closer to Kurokawa and the Metabolists—a specific interest in the way individual rooms become the key generating element in an orderly hierarchy of spaces forming small clusters of rooms in plan, which then become the basis of nodes within a larger social organisation.<sup>7</sup>

6. Philip Drew, *Third Generation: The Changing Meaning of Architecture* (New York: Praeger, 1972), 68.

Beyond this set of similarities is the particular issue of open form in architecture that is signaled through Andrews' choice of plan type. The pinwheel plan adopted for the Stelco project was a very particular one in the context of the day that also reflected a continuity of architectural thinking from the inter-war to the post-war period.

7. Drew, *Third Generation*.

In Andrews' Stelco project the pinwheel plan is used both practically and symbolically to describe flexibility and change. At a practical level the plan takes the form of four rectilinear axial elements offset from each other arranged around a central vertical core and is used for the systematic distribution of people and services around the core. Sketch drawings show circulation passages along the arms of the pinwheel coloured yellow giving access to identically sized modular apartments. The pinwheel form allows four apartments per floor, each orientated differently yet neatly combined within a large square plan. A long edge of each apartment is located on the perimeter allowing modules to be replaced at will by use of a crane externally. Other plans show the distribution of services from the core along the pinwheel arms and the passage of ventilation from the exterior similarly aligned by the plan pattern. The pinwheel is also represented sculpturally and symbolically, atop the lift tower, revealing the pattern that determines the component form of the structure.<sup>8</sup> Symbolically the pinwheel plan denotes movement and

change as well as additive growth, represented in its image of elements arrayed around a central form or nucleus.

Looking back to the inter-war period, the origin of the pinwheel plan in the twentieth century lies in the work of Le Corbusier who begins a modern interest in the pinwheel form through experiments with spiral planning begun in 1923—plans that also denote movement, change and additive growth.<sup>9</sup> The pinwheel form emerges where Le Corbusier inserts axial forms into spiral plans for the Bata Exposition Pavilion (1935) and the Centre of Contemporary Design (1936), which the architect refers to as a series of “diagonal or orthogonal crosspieces.”<sup>10</sup> The pinwheel form eventually crystallized in the Museum of Unlimited Growth project (1939), described by the architect as a ‘swastika’ form, where it first appears as a distinct figure overlaid upon a square spiral plan. The arms of the pinwheel were inserted to create free circulation between the building’s centre and outer edge that could later extend to accommodate the museum’s expansion. The pinwheel (or swastika) and spiral plans are closely related formally and conceptually through Le Corbusier’s use of them. Both were associated by him with concepts of growth and flexibility in architecture, with the patterning of the plan in each case seen as a means to interrelate program and structure while accommodating movement and the extension of the plan.

Out of the work of Le Corbusier the pinwheel became prominent internationally in the 1950s and was adopted by various members of Team 10 and its circle between 1950 and 1963 where it was used for single buildings as well as in urban plans. In 1950 the pinwheel form appears in Alison Smithson’s Royal Academy thesis scheme, a use clearly recalling Le Corbusier’s project for the Museum of Unlimited Growth (1939).<sup>11</sup> Pinwheels are also evident in experimental housing layouts by Candilis, Josic and Woods of the 1950s subsequently taken up in their 1960s urban project for Toulouse le Mirail, France.<sup>12</sup> In 1951 a pinwheel form is used by Stirling and Gowan as the pattern of structural assembly for their “Stiff Dom-ino Housing” project, a flexible cellular home that can be deployed as a single unit, grouped in clusters or in a row house form, which refers in name to Le Corbusier’s famous prototype.<sup>13</sup> A variant of the pinwheel plan is also used in their 1957 project for an “Expandable House.”<sup>14</sup> Organised as a set of quadrants around a circular service core, the house can be added to over time as the needs of the family grow. A vestigial form of the pinwheel is realised in the modular scheme for the School Assembly Hall,

8. John Andrews, “Stelco Modular Apartment,” sketch plan drawings, CAA, 127A/Box 1.

9. The set of projects includes Villa La Roche-Jeanerret (1923), Villa Meyer (1925), Mundaneum (1928), Museum of Contemporary Art (1931), Bata Boutique (1935), University Campus, Rio de Janeiro (1936), Centre of Contemporary Aesthetics (1936), Pavillon des Temps Nouveau (1936), Museum of Unlimited Growth (1939), Exposition Habitat 45 (1945), Urban Development, Saint-Die (1946), Exposition Synthèse Des Arts, Port Maillot (1949), Cultural Centre of Ahmedabad (1951), Tokyo Museum (1955), Etude d’urbanisation, Meaux (1957), Museum at Chandigarh (1957), Cultural Centre, Chad (1960), Museum of the Twentieth Century, Eirenbach (1963), Museum of the Twentieth Century, Nanterre (1965), Musée de lotissement (undated)

10. Le Corbusier, *Oeuvre Complète 1934-1938* (London: Thames & Hudson, 1964), 154.

11. Alison Smithson, “How to Recognize and Read Mat-building,” in *Case: Le Corbusier’s Venice Hospital*, ed. Hashim Sarkis (Munich: Prestel Verlag, 2001): 102.

12. Smithson, “How to Recognize and Read Mat-building,” 98.



Camberwell, 1958.<sup>15</sup> The building's square plan is arranged into quadrants covered by sloping roofs that appear to rotate around its centre.

13. James Stirling, *James Stirling: Buildings and Projects 1950-74* (London: Thames and Hudson, 1975), 130.

14. Stirling, *Buildings and Projects*, 135.

In the same year Aldo van Eyck's design for the Congress Building for Jerusalem features a set of courtyards arranged in a pinwheel form.<sup>16</sup> Van Eyck's diagrams of the complex show dotted lines through courtyard spaces arranged centrifugally that create, in the architect's words, "a square ... that breathes."<sup>17</sup> Its plan is organised as if to imply the pulsation of space with the passage and flow of movement. In 1962 van Eyck creates an urban design for Buikslotermeer, Amsterdam, with Jaap Bakema based on the interweaving of pinwheel plans in clusters creating a hierarchy of major and minor forms across the whole.<sup>18</sup> Taking this arrangement to another level of formal complexity was Piet Blom's "Noah's Ark" project (1962).<sup>19</sup> Presented by van Eyck at the Team 10 meeting at Royaumont in the same year as its design, Blom's scheme clustered and overlaid a series of pinwheel plans creating a diagrammatic urban form that included multiple part to whole relationships intended to articulate a hierarchy of scales spanning from the individual house to the collective form of the city. At a far smaller scale in van Eyck's "Wheels of Heaven" Protestant Church, Driebergen (1963) the pinwheel form is subtly observed in the layout of skylights over the four circular chapel spaces at the heart of the plan, implying the rotational movement of spaces.<sup>20</sup>

15. Stirling, *Buildings and Projects*, 138.

16. Aldo Van Eyck, *Works* (Basel: Birkhäuser, 1999), 114-15.

17. Van Eyck, *Works*, 115.

18. Van Eyck, *Works*, 118-19.

19. Francis Strauven, *Aldo van Eyck: The Shape of Relativity* (Amsterdam: Architectura & Natura, 1998), 339.

20. Van Eyck, *Works*, 122-25.

The pinwheel plan, used by members of Team 10 and their circle, served the practical and symbolic purpose of highlighting concepts of flexibility, movement, growth and extension represented in architectural and urban form—an array of concepts that can be traced back to similar claims in the work of Le Corbusier. As a possible "solution" to the problem of finding open form the pinwheel plan was seen to anticipate, in its geometric but loose order, the potential for a nuanced response to social need (individual and collective behavior) in the context of postwar reconstruction. Andrews clearly appropriates the plan's form along with its conceptual meaning for his Stelco project—emphasising flexibility, growth and change as key aspects of the design.

Yet the Stelco project is only a staging point for Andrews' more studied appropriation of the pinwheel plan. In early 1965 the architect begins work on the scheme for the Bellmere Primary School, a commission offered by the Scarborough Board of Education based on the success of his earlier breakthrough project, Scarborough College.<sup>21</sup> Andrews' social aims for the project were foremost, an

21. Andrews and Taylor, *Architecture*, 50.

approach that would bring him into conflict with the commissioning authorities. In his book *Architecture: a performing art*, Andrews describes a child-centred approach to the design, one that sought to evoke a familiar domestic scale environment for students while avoiding the kinds of institutional controls thought necessary in the surveillance of their behavior, such as long axial corridors for the visual monitoring of space. Andrews' solution was to develop a one-storey complex based on clusters of four top-lit classrooms gathered at each corner of a large central general-purpose space that could be extended over time and linked to other clusters branching across the school campus. In Andrews' own words, his office had successfully created a building that "avoided the inefficiencies of the centrally-loaded corridor structure and could utilize the concept of selected incremental growth."<sup>22</sup>

22. Andrews and Taylor, *Architecture*, 52.

Schematically the plan features pinwheel forms at two scales. At the macro scale of the whole the pinwheel is seen in the gathering of clusters of classrooms at the corners of a large gymnasium space at the centre of the complex. At a micro scale the pinwheel is evident in the linking space between the classroom clusters that provide small gathering areas between classrooms. As the corridors connect to further classroom clusters they create a zig-zag passage between the interlinked pinwheels, producing a meandering form that seeks to recreate a domestic scale for the young students, one that was designed to counter issues of alienation that Andrews saw as the key problem of school buildings as an institutional type. Elsewhere the architect writes in typically frank style of an approach to architecture incorporating broader social aims into planning as follows:

The organization of functions does not mean what is currently understood as Bauhaus functionalism: the shortest distance to the toilet. Function is as much a matter of environment as it is of distance and measurable convenience. Functionalism must relate to people in a common sense way, not through ritualized formulae.<sup>23</sup>

23. Andrews and Taylor, *Architecture*, 83.

Andrews' common sense approach to social concerns through architecture is directly addressed through the patterning of his architectural plans. In his Bellmere School project the pinwheel becomes a vehicle for ameliorating problems of an entrenched institutional type that had lost sight of the way in which architecture could positively engage human behaviour, and again this thinking directly aligns Andrews to contemporary architects within Team 10 and their circle. The staggering plan arrangement of classrooms at Bellmere recalls Aldo van Eyck's Municipal Orphanage,



Amsterdam (1955-60) a project that proved seminal for the way in which its spaces were organized and scaled for child users.<sup>24</sup> In both there is an implied diagonality of movement, broken down to the scale of the building's occupants, by stepping forms across the plan. In formal terms Andrews' architecture of low walls with peaked roof structures above square formed classrooms evokes the patterning of Louis Kahn's Bath House at the Jewish Community Centre, Trenton, New Jersey (1954-58). Yet beyond these formal comparisons are underlying social concerns that Andrews shared with his contemporaries. For Andrews in particular, the attempt to reconcile the individual with the collective by architectural means in the Bellmere project would later prove key to the Guelph Residences project.

24. Strauven, *Aldo van Eyck*, 284-325.

Yet almost in parallel with Andrews' use of the pinwheel plan, the meaning attributed to pinwheels as plans was being contested in international circles in Europe. At the Team 10 meeting at Royauumont in September 1962, Aldo van Eyck presented a project by an "understudy," Piet Blom. As previously mentioned Blom's "Noah's Ark" scheme was an attempt to articulate a hierarchy of scales spanning from the individual house to the collective form of the city using interlocking pinwheels as a means to overcome the alienating and sterile forms of modernist urban plans. Francis Strauven notes how, for van Eyck, Blom's project had succeeded in answering the problem of reconciling part and whole in the urban context by revealing the essential equivalence of both. That the pinwheel form could characterise the whole and the part simultaneously, at different yet interrelated scales, provided a fundamental clue in a search to address alienation as a consequence of new urban planning. As Strauven also notes, van Eyck's conclusion was not met with universal acclaim and Alison and Peter Smithson were vehemently critical of the scheme. For Alison Smithson the rigorous patterning of urban form produced by the plan left no room for individual freedom, amounting to "a pre-programming of all functions and activities."<sup>25</sup> Seeming to set aside her own use of the pinwheel in 1950, Smithson accused Blom of adopting a motif that was "completely fascist,"<sup>26</sup> a reference to the swastika form that the pinwheel also conjured. The British architect John Voelcker was equally critical seeing the project as disconnected from any concrete vision of reality, merely becoming "an image of an image."<sup>27</sup>

25. Strauven, *Aldo van Eyck*, 400.

Despite committed belief in the pinwheel plan as a means to address new social forms, the type began to lose its currency by the mid 1960s. Within Team 10 it was now characterised as a dualistic

26. Strauven, *Aldo van Eyck*, 400.

image, slipping uncomfortably between uses as mechanism and metaphor. On the positive side it had been seen as a means to organize relationships between part and whole flexibly and organically while also representing movement, change and incremental growth as intentions for architecture. On the negative side its strong figural character now became seen as too fixed and over determining for use as a plan, metaphorically conjuring related images with fascist overtones.

27. Strauven, *Aldo van Eyck*, 399.

For John Andrews too, the pinwheel plan had become redundant after the Bellmere School project, separately from debates in Europe, but for similar reasons to its rejection by some members of Team 10 at Royaumont. Nonetheless its use was of critical importance to the architect in the development of his design practice, providing a bridge to his work with grids and diagonals. Through Andrews' reflections on the Bellmere project in *Architecture: a performing art* it is possible understand the greater meaning that the architect himself attached to the project—a meaning that strongly guided the architect's design thinking at a seminal period in his career.

In Andrews' own terms the project for Bellmere had failed to adequately meet the social aims with which the project had begun. As the architect states in reflection on the work: “[w]e did not develop the interior-cum-circulation spaces sufficiently in terms of the little people using them. There should have been more places to sit and more things conducive to play.”<sup>28</sup> At one level this comment can be seen as reflection on the limits of the plan to afford variations in spatial arrangement catered to the needs of students, as if the tailoring of scale offered by the interlocking plans devised had not proved flexible enough to genuinely address the social aims initiating the project. Nonetheless the architect describes his work on Bellmere as vital to a key realization for his practice, namely, that, “all architectural problems are the same, they only vary in dimension.”<sup>29</sup> Understanding parallel discussions within Team 10 it is possible gather the implications of Andrews' commentary. As van Eyck had observed of Blom's Noah's Ark project, a key to conceiving the relationship between part and whole in architecture lay in understanding the equivalence of architectural problems at each scale and their essential similarity. Andrews' use of the pinwheel form simultaneously at the macro and micro scale for the Bellmore project—the interleaving of similar elements at different scales—also proved revelatory for exposing this idea (as it had been for van Eyck in witnessing Blom's project).

28. Andrews and Taylor, *Architecture*, 53.

29. Andrews and Taylor, *Architecture*, 53.



Yet the pinwheel form, in revealing such a possibility, had now outlived its usefulness for Andrews and he would never again use it as a generating plan. As the architect began work on the South Residences at Guelph in late 1965, a project that in its prodigious scale would fully test Andrews' ability to reconcile part to whole, the architect famously enacts the strategy of overlaying diagonals on grids to organise relationships between rooms, clusters and nodes on linear circulation routes—a strategy that would become a mainstay of his design practice. The decision to combine diagonals and grids provided a freedom to the architect not previously evident in his plans, though it is evident that the design approach arrived at for Guelph was latent in the plan for Bellmere. The interlinking of pinwheels, and the staggering of circulation passages, implied an underlying diagonality of movement in the plan that was tactically suppressed. Seizing the opportunity to dispense with the pinwheel as a fixed form for clustering elements of his architecture meant recognising the possibility of separating out diagonal circulation passages from orthogonal grids as realised at Guelph, only for those elements to be reintegrated through a higher-level ordering strategy. The basic cell of the plan (the student rooms) were formed by a geometry identical to that of a larger extensible order of clusters and passageways. At once, part to whole relationships in plan could be expressed flexibly over an extended field rather than incrementally, by adding part to part, as was the case with the pinwheel plan.

Andrews' search for open form had yielded a new paradigm in his planning technique, which he deployed beyond the scale of the campus to the larger urban scale of the city in the unrealised proposal for the Metro City Plan, Toronto (1970). Here Andrews appropriates the existing downtown grid to generate a new urban schema over the former railway yards, creating an extensible field of diagonals to the grid for laying out new high-rise developments in the city.

The lessons achieved in the planning of Bellmere brought Andrews to a greater understanding of methods for architecture, taking his design thinking well beyond the implications of the pinwheel plan that formed its basis. The establishment of an important aspect of the architect's mature style of the planning in his University of Guelph South Residences would eventually mark an important legacy of the architect's work for the culture of contemporary architecture, as the work of Andrews' practice continued to unfold over the following three decades.<sup>30</sup>

30. The research of this paper including travel to the Canadian Architectural Archive, Calgary, is supported by a 2012-2014 Australia Research Council Discovery Grant entitled *John Andrews: Making Architectural Identity*.