

# Le Corbusier's research-based design approaches

Gerald Steyn

Tshwane University of Technology

Email: steyns@tut.ac.za

The ability to convincingly demonstrate the integration of and reciprocal dynamic between research and product in design assignments is now a prerequisite at most institutions of architectural learning. Due to the creative aspects of design and the undeniable significance of value judgment and imagination in decision-making, this cannot be taught or prescribed as a neat sequential methodology. The best way to understand the role of research is arguably to study how eminent architects have achieved this synthesis. Fortunately Le Corbusier (1887-1965) published copiously; from early exploratory sketches to descriptive essays after completion. Using Chandigarh (the capital of Punjab in India and his only built city) as a case study, this paper examines the research that informed its town planning and the design of some distinctive buildings.

**Key words:** Le Corbusier, Chandigarh, architectural research

## Le Corbusier se navorsingsgerigte ontwerpbenaderings

Die vermoë om oortuigend die integrasie van en wisselwerking tussen navorsing en produk in ontwerptake te demonstreer is nou 'n voorvereiste by die meeste instansies van argitektuuronderrig. As gevolg van die skeppende aspekte van ontwerp en die onbetwyfelbare belangrikheid van waardebeoordeling en verbeelding in besluitneming, kan dit nie geleer of as 'n netjiese opeenvolgende metodologie geleer word nie. Die beste manier om die rol van navorsing te verstaan, is waarskynlik om te bestudeer hoe vooraanstaande argitekte hierdie sintese bewerkstellig. Gelukkig het Le Corbusier (1887-1965) roomskoots gepubliseer, van vroeë ondersoekende sketse tot beskrywende werkstukke na voltooiing. Met Chandigarh (die hoofstad van Punjab in Indië en sy enigste geboude stad) as gevallestudie, ondersoek hierdie artikel die navorsing wat die stadsbeplanning en ontwerp van sommige kenmerkende geboue ingelig het.

**Sleutelwoorde:** Le Corbusier, Chandigarh, argitektoniese navorsing

**R**ated institutions of architectural learning expound views that students' design schemes should describe process as well as product. In fact, most insist on a substantial proportion of research, especially in final year design theses. In the real world of practice, no architect would ever present anything but a final design to a client. That does not mean architects do not carry out research; in fact, award-winning projects tend to grapple with complex issues beyond the purely programmatic, which is clear evidence of considerable inquiry. But it is the outcome of those issues that are published rather than the decision-making behind them.

How can students learn about “process” if the really good architects rarely share theirs? Le Corbusier (1889-1965), arguably the most influential architect of the 20<sup>th</sup> century, fortunately had the propensity to publish copiously, from doodles to developed designs, often with the rationale included (*Oeuvre Complète* Volumes 1-8). Le Corbusier is an eminently suitable example of an architect that unfolded and developed design by applying process rigorously. He pioneered a number of paradigms during his career, which, from the taut, white Purist buildings of the 1920s to the rough, bold monumentality of Chandigarh's Capitol Complex in the 1950s, is intellectual and a giant creative leap.

Le Corbusier invented a number of systems that were certainly based on empirical research such as Dom-ino (concrete slab-and-column), Modulor (proportions and measurements), Le Brevet (welded metal frame) and the V7 street classification. His writings on urbanism can be described as scholarly in the broadest sense, although they are widely regarded simply as

polemical stances. This article focuses on his approaches to the research that informed his town planning and architecture by investigating the design development of four built aspects of Chandigarh: (1) the city plan, (2) a commercial street, (3) a low-income housing project, and (4) the High Court.

Apart from scrutinising his drawings and written explanations, comments by Balkrishna Doshi, who worked for four years with Le Corbusier as Senior Designer (1951-54) in Paris and four more years in India to supervise his projects in Ahmedabad, proved informative.

### **Chandigarh: Origins and intentions**

Chandigarh is located northwest of Delhi, just south of the Shivalik Mountains, the foothills of the Himalayas. The Indian province of Punjab needed a new capitol after Partition in 1947, when India was divided into Hindu India and Muslim Pakistan. Matthew Nowicki and Albert Mayer created the initial masterplan. Le Corbusier was invited to participate after Nowicki died in a plane crash in 1950; he started work in 1951. His collaborators were his cousin, Pierre Jeanneret, Maxwell Fry and Jane Drew, as well as number of young Indian architects and planners.

### **Town planning**

A frequent assertion is that Le Corbusier simply modified the leaf-shaped Nowicki-Mayer plan, perhaps because he had completed his layout in just four weeks (*Oeuvre complete*, volume 6: 51). It is certainly true that he retained certain characteristics, especially spatial relationships between key elements (government, city centre, university and industries) and the superblock principle, but his town planning scheme was based on the investigation of a very broad set of considerations. Le Corbusier (1958: 210) claims that he had revived the unbuilt proposal for Bogota, which he had drafted during the previous year. That proposal, in turn, is a reminder of Radburn, with the curved roads straightened out, the informal, meandering footpaths, and the greens with their organic edges retained and linking the superblocks across ring roads – clearly a case of applying an existing concept (and theory) to a new setting.

Charles Jencks (2000: 324) recognises that “Other critics, especially city planning theorists such as Jane Jacobs, have faulted Le Corbusier for taking an overly simplistic view of the way the city functions. William Curtis (1986: 224), however, writes that when Le Corbusier “did have a chance to lay out a whole town, at Chandigarh, he modified his abstract propositions considerably to deal with site, climate, culture and tradition”.

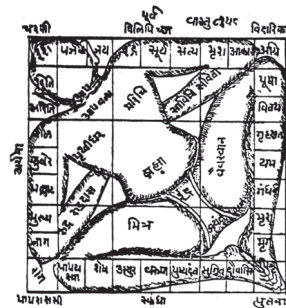
Browsing through Le Corbusier’s published work on Chandigarh, one notices the sketches of the terrain, cows, flowers, symbols and ordinary people. Rémi Papillaut (2002: 324) notes that Le Corbusier did not have a large collection of books about India, but rather seemed to “develop knowledge based on visual intuition”. This is corroborated by Balkrishna Doshi (in Takhar 2002: 58) who writes that Le Corbusier observed life styles and the impacts of the climate, flora and fauna at a spiritual and material level in everyday life: “Over the next few years, I gradually experienced his interpretations and translations of these observations into design.”



**Figure 1**  
**Landscape with a view of the Shivalik Mountains (*Oeuvre complete*, volume 5: 115).**

He was acutely aware of India's myths, iconography and urban history. Although not as widely published as the first cities of the Middle East, India, and specifically the Indus Valley, has a long urban history. The Harappan cities existed between 2150 and 1750 BC, and were the earliest examples of the gridiron plan (Morris 1994: 31). The rules for making these ancient cities were described in the Vaastu. Doshi writes (in Takhar 2002: 65):

The Vastu Shastra ... is an ancient treatise, which says that architecture is connected to the environment ... He [Corbu] drew a diagram to understand this approach. ... He made a drawing for himself trying to interpret them for their psychic, figurative and material values.



**Figure 2**  
**Vāstu-purusa mandala (from Lynch 1981: 76).**

After *Contemporary City* and *Radiant City*, which were both purely diagrammatic proposals for fictional sites, Le Corbusier abandoned the symmetrical grid and from 1929 to 1945 he designed juxtaposed nets with different geometries for vehicles and pedestrians, often based on curvilinear, trigonometric and linear forms. Chandigarh signalled a return to the grid, and it is not inconceivable that the mandala persuaded him to do so. Superblocks with standardised dimensions also offer the advantage of nearly unlimited incremental, modular expansion.

Very early in his career Le Corbusier defined four town planning principles (1929: 170): (1) the centres of cities must be de-congested, (2) density must be increased, (3) circulation and mobility must be improved, and (4) parks and open spaces must be increased. These he pursued relentlessly all his life, as reflected in his very first drawings.

Fast moving traffic is restricted to the surrounding V1, V2 and V3 roads. These are highways, boulevards and ring roads bounding the superblocks, called sectors, respectively. V4 is an internal bazaar street, V5 a rather narrow looped internal neighbourhood street, and V6, the lanes into the estates and street blocks. V7 is a footpath in a green strip. Noticing the large number of bicycles and rickshaws, he later added V8 lanes. Figure 4 illustrates just how closely the final plan resembles the initial layout. While Le Corbusier certainly guided the layout of the V4, V5 and V7 streets and paths, he (quite uncharacteristically) allowed others to design the finer V6 streets.

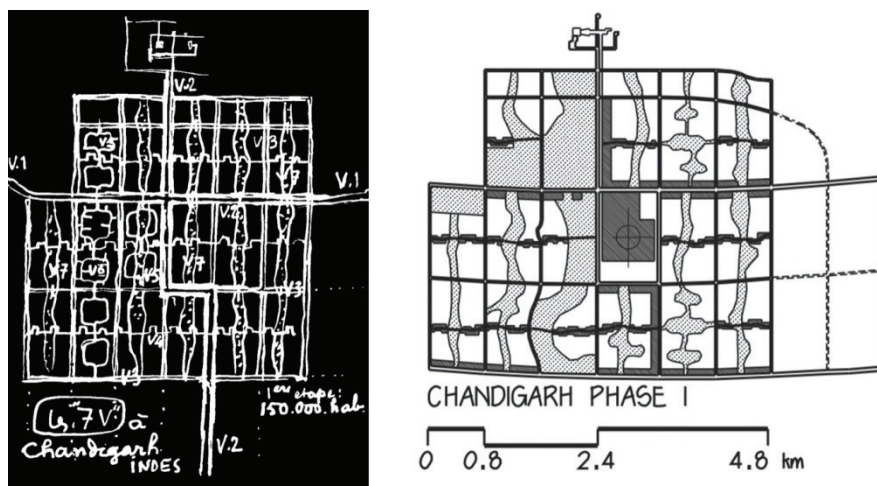


Figure 3  
 Early sketch by Le Corbusier and as-built  
 (diagramme from Le Corbusier 1958: 211; plan of Phase 1 by the author).

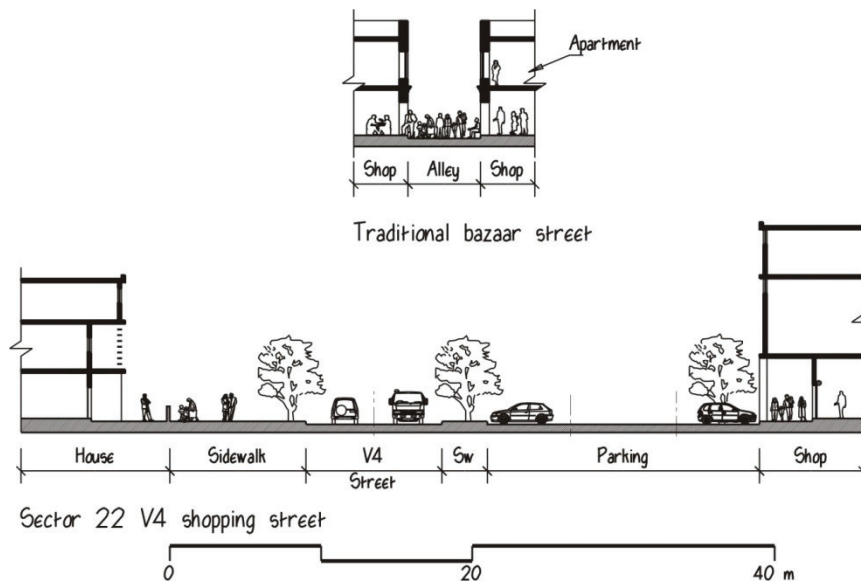
Chandigarh is still being criticised for not being “Indian”, probably because critics expect the frenzied ambience of Old Delhi. The brief from the Indian government, however, insisted on a modern and efficient city, with Jawaharlal Nehru, the first Prime Minister, speaking of “clean open spaces liberating Indians from the tyranny of the overcrowded and filthy cities, as well as from the confines of agricultural village life” (Curtis 1986: 189). With each sector, especially the residential ones, constituting a walkable and relatively self-contained urban village, bisected by the most prevalent of Indian urban typologies, the bazaar street, and envisaging a compact, low-rise residential form, how much more Indian could the critics have hoped for?

### The V4 commercial street in Sector 22

Apart from the mixed-use nature of the sectors, I find Le Corbusier’s comments on the so-called V4 streets – the east-west trading streets that bisect the sectors – particularly revealing (*Oeuvre complète*, volume 5: 114):

The V4 is the shopping street running from left to right, which supplies all the needs of the sectors in the way of shops and tradesman’s services, corresponding in a manner to the “la grand-rue” of yesterday. This street is deeply rooted in Indian custom. The V4 crosses the town horizontally. It ensures continuity and neighbourliness between sector and sector. Here the traffic moves more slowly.

I expected the bazaar streets to resemble those in Delhi, but they make adequate provision for cars and parking. However, the shops, however, are indeed bustling. When Chandigarh was planned, India was recovering from the trauma of Partition and a British overrule. It was an impoverished country, not industrialised and the economy was primarily agricultural (Gayatri 2009). Few people owned cars and most urban households relied on walking, bicycles and rickshaw taxis. Le Corbusier, however, clearly anticipated that India would evolve into a major power together with all the material accretions (including private cars) that are associated with increased affluence. As Ravi Kalia (2002: 419) writes: “Le Corbusier looked towards India’s future, to an India with all the paraphernalia of industrialization.” Rémi Papillaut (2002: 324) is certainly correct when he writes that Le Corbusier’s design for Chandigarh has a universality based on “his vision of the modernity of India.



**Figure 4**  
Sector 22 V4 shopping street – predictive  
(survey and drawing by the author).

## Design codes

Le Corbusier writes that he sketched the studies (Figure 5) one night in his hotel in Mumbai, referring to them as his “research” (*Oeuvre complete*, volume 7: 69). This is of course not unique among architects. As Bryan Lawson (1980: 94) writes: “The whole purpose of doodles, sketches or models is to act as a kind of additional memory to freeze and store spatial ideas which can then be evaluated and manipulated”. As evident in his sketches, Le Corbusier not only recognised the need to respond to the sun, heat and rain, but also managed to capture the patterns found in the local architecture.

Another method was his reinterpretation of historical precedent, as he elucidates: “Past history provides us with innumerable and forceful examples. Foresight and control are essential” (Le Corbusier 1929: 264). His sketchbooks and writings reveal that he analysed historical precedents in great depth. In fact, he wrote (quoted in Curtis 1986: 36): “The greatness of past inventions should be repeated not through imitation, but through a reiteration of constants, and a search for equivalent magnificence in modern terms”.

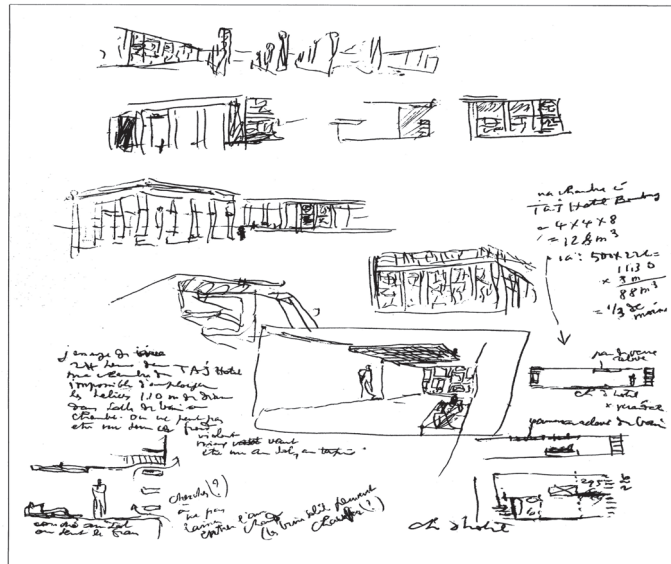
The constants are of course typological patterns. Michael Graves (1981: 8) notes that while Le Corbusier was “always aware of historical precedent, his interpretation was never literal, for he drew in a manner that transformed history into typology, a way for him to organize his thoughts relative to his own compositions” (Graves 1981: 8).

Learning by looking is an accepted approach. In their informative book entitled *Architectural Research Methods*, Groat and Wang (2002) offer a number of frameworks for architectural research, one of which is the “subjective” (qualitative) paradigm required for informal observation.

He also reinterpreted his own previously developed concepts. Villa Baizeau in Carthage, Tunisia (1928-1929) first featured overhangs and a design that opens up to the breeze, the pattern of which culminated, as Le Corbusier (1960: 81) himself claimed, in the formulation of the



brise-soleil and its use in the Capitol Complex. However, as Doshi (in Takhar 2002: 58) reminds us: “References from earlier works were only references and the thrust was on an approach suitable to India ...”.



**Figure 5**  
**Observation of contemporary elements (*Oeuvre complete*, volume 7: 104).**

### Housing for poor people

During his visits to Algeria (1929-1942), Le Corbusier realised that vernacular type-forms evolved through a rigorous process of adaptation and tradition, and he subsequently searched for ways of “blending the substructures of the vernacular – their principles of organization – with the rules of his own vocabulary” (Risselada 1989: 60). From the beginning, he realised that an Indian house was different from a Western one and therefore studied the Indian vernacular in an effort to capture its essence.



**Figure 6**  
**Indian farmstead (*Oeuvre complete*, volume 5: 118).**

Le Corbusier is continuously criticised for disregarding the intangibles – social and economic considerations – but in his conception of the bazaar street and housing for low-income workers, he certainly demonstrated understanding and responded quite appropriately. Le Corbusier’s team was instructed to design thirteen housing types for the different classes of government employees. He realised, however, that low-income workers were not provided for and initiated a fourteenth type. Here, based on his observations of the vernacular, he demonstrates adequate understanding of the way a Hindu family uses a house and provided a veranda allowing for

sheltered outdoor cooking, a courtyard and an outside toilet. For the roof, he retrieved the barrel vault, first conceived for his unbuilt Monol housing in 1919. His proposal was not built, however, a derivative scheme by Jeanneret and Malhotra was.

Was Le Corbusier qualified to deal with social issues? Should he have relied on interdisciplinary collaboration? Apparently not. Bryan Lawson (1980: 67) writes that “by and large this liaison between design and social sciences has not been as practically useful as was first hoped. Social science remains largely descriptive while design is necessarily prescriptive”. A case in point is the South Africa architect, Peter Rich, who made a career of working in rural and informal settlements, and at the World Architecture Festival of 2009 won the World Building of the Year award for the Mapungubwe Interpretation Centre in South Africa. He points out that architects are uniquely equipped as observers of social behaviour through training and inclination (personal interview).

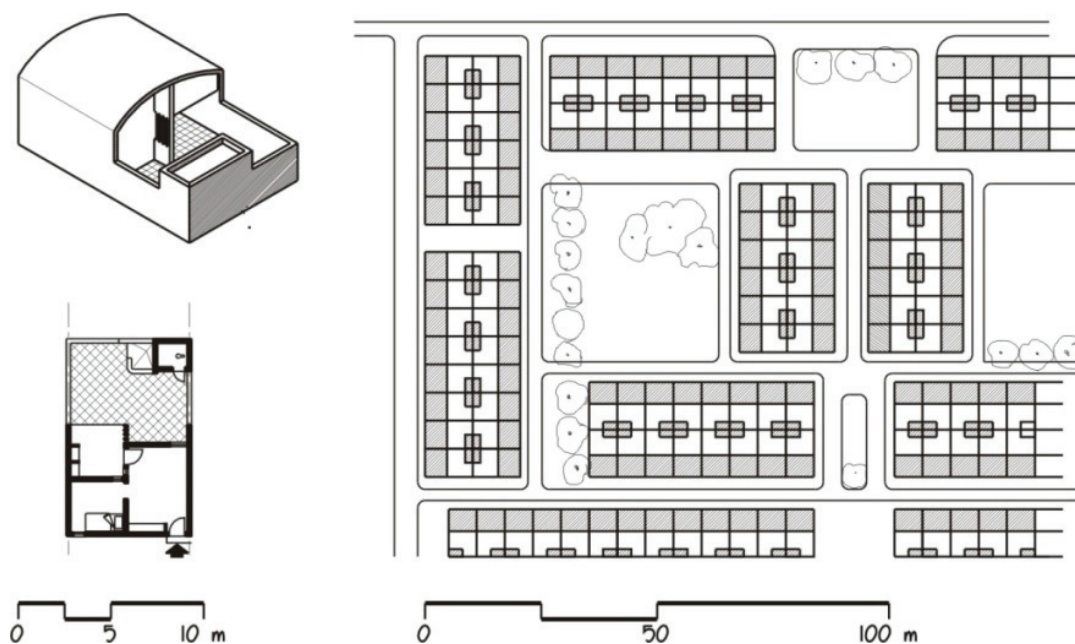


Figure 7  
 Vernacular inspiration – low-cost housing by Jeanneret and Jeet Malhotra  
 (drawing by the author – unit and site plan after Mehta 2005: 58).

### The Capitol Complex – the High Court

According to Curtis, Le Corbusier told Varma that the High Court is “about the majesty, the strength and the shelter of the law”. This was most certainly a case of post-rationalisation. Curtis recognised that Le Corbusier was “fascinated by double systems of articulation in Moghul architecture” (in Takhar 2002: 52); his earliest sketches of the High Court clearly depict his interpretation. This is another instance of using a historical typology to formulate a concept. The sketches of the high court indicate that Le Corbusier would decide on a concept very quickly, and evolve the design from it. As Doshi writes (in Takhar (2002: 59):

Being methodical and precise, he would expect us to transform a stamp-sized conceptual sketch he had made in India into a design. While developing it, he would ask us to follow-up all other relevant information including the climatic grid which was prepared in the studio to study air movement, sun path, humidity, rain fall, etc. to decide orientation, materials, openings, methods of construction, among other things. The brief would be vague initially but would be developed and detailed constantly.

A few pertinent points arise from this. First, Le Corbusier never doubted his first concept, unless he threw sketches of alternatives away, which is unlikely. Bryan Lawson (1980: 34) relates how Jane Darke, reporting on extensive research, mapped the design process as generator-conjecture-analysis, reporting that many architects she interviewed would first identify a pertinent aspect of the design problem, and then “develop a crude design on this basis and examine it to see what else [they] can discover about the problem”. Bryan Lawson (1980: 114) avers that “[creative artists] clearly demonstrate qualities of perseverance and single-mindedness not usually associated with divergent thought”.

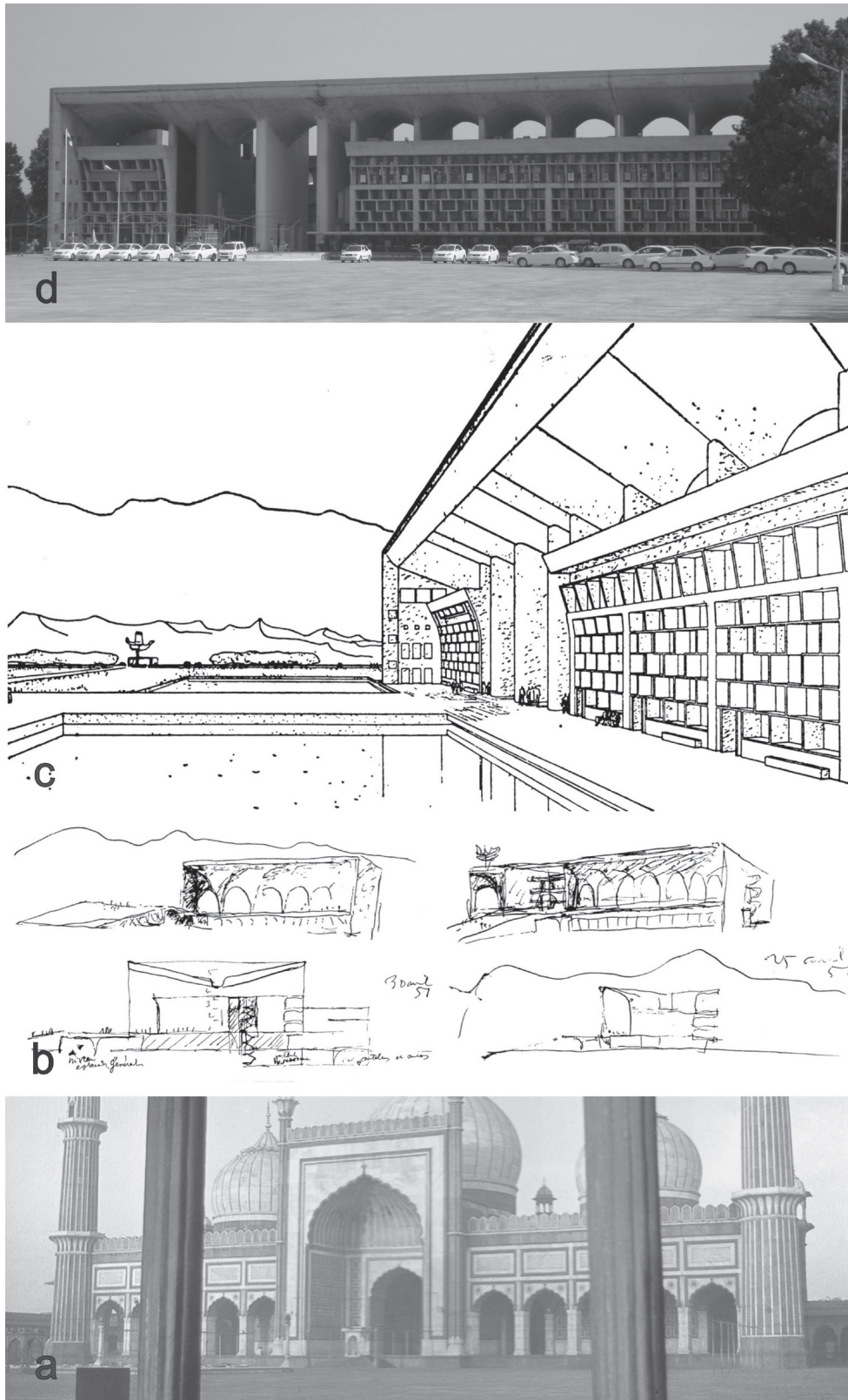
Second, the design evolves through iteration and backtracking and congruent research. Balkrishna Doshi (in Takhar 2002: 58) writes: “For [Le Corbusier] discovery had to happen at all scales and without constraints.” Groat and Wang (2002: 114), referring to Darke in Lawson above, write that “architects, when given design problems with very complex programmatic and social-cultural considerations, nevertheless tend to start by proposing very simple figural schemas. Over the design process, a schema is analyzed, refined, tested, analyzed again, and so on, until a more responsive schema emerges”. Bryan Lawson (1980: 34) repeats a quote from Jane Darke’s research, noting that “even the briefing stage needs to be accessible by return loops”: “You can’t start with a brief and (then) design, you have to start designing and briefing simultaneously, because the two activities are completely integrated”.

Peter Rowe (1987: 103) writes: “It becomes evident when one examines the structure of problem solving in architectural design that the distinction of problem definition, solution generation, and solution evaluation as independent stages does not entirely obtain.” That is because “The validity and import of the new information may not be fully apparent until subsequent steps have been taken making use of the information” (Peter Rowe 1987: 95).

One gains the impression that symbolism had already been captured in the concept, and that the pragmatic research Doshi referred to simply served to refine the design. That was not always Le Corbusier’s approach. His first carpet layout, however, was the much earlier design of a university quarter in 1925. In a brief description, he reveals his method of design (1927: 260-261): “We have to classify, form a type and settle the form of the cell and its elements. Economy. Efficiency. And Architecture? We can always achieve it when the problem is clear”.

It is interesting that he considered what is currently popularly called “planning” a rational, exploratory process aimed at solving typological, functional and budgetary issues. “Achieving architecture” seems to be not only the more creative and poetic process of modulation and elevational treatment, but also that of determining the construction, a process we tend to associate with practical thinking.





**Figure 8**

**High Court – Historical precedent**

**8a: Mughal architecture in Delhi – Friday Mosque (from Dickie 1978: 21)**

**8b: Concept sketches (*Oeuvre complete*, volume 5: 126)**

**8c: Presentation drawing (Le Corbusier 1958: 225)**

**8d: As-built (source: the author).**

## Assessment

Architects are often accused of neglecting social, cultural, and political considerations in favour of aesthetics. Le Corbusier's research focused on symbolism rather than imagery, and on climate as well as social and cultural patterns.

We know what inspired and informed them, but how he actually synthesised his ideas into designs cannot be explained. As Bryan Lawson (1980: 109) writes: "Studies of gifted individuals generally recognised as creative fail to provide evidence of any obvious and clear process at work." We have to accept that the process that shapes architectural designs cannot be wholly empirically described, simply because "design involves figural as well as systemic considerations" (Groat and Wang 2002: 103).

Le Corbusier also developed "conceptual strategies" and formal skills by painting every day (Baker 1996: 289-290). Painting was one of Le Corbusier's passions and his comments are certainly revealing (1960: 219): "Painting is a bitter struggle, terrifying, pitiless, unseen; a duel between the artist and himself. The struggle goes on inside, hidden on the surface. If the artist tells, he is betraying himself!"

Was architecture and town planning less of a struggle for him? I do not think so. He clearly tried to make it easier by means of conceptualisation through spatially structured typologies rather than parti, which are more abstract organising ideas. He applied two approaches. The first was pattern recognition – the direct experience of gathering empirical evidence in order to form precepts rooted in reality. The precepts are then abstracted into concepts through discursive thinking based on logic.

The second is based on experience, norms and types. Peter Rowe (1991: 122), like many others, recognised that Le Corbusier not only had a number of "preferred spatial concepts", but also often employed "formal type as a guiding idea". He suggests that Le Corbusier used analogy (1991: 31), both from historical precedent and from concepts that he previously developed, and "design rules" (1991: 65). That approach ensured that a conspectus of ideas – his toolkit – was intermittently tested and refined. The trajectory of Contemporary City to Chandigarh 30 years later clearly demonstrates that.

The use of quick freehand sketches is a prominent feature of his design process. It could be argued that with the increasing refinement of CAD draughting and modelling systems it is an obsolete medium. However, after the initial fascination with computer-generated drawings, the value of sketching and hand drawings are being reconsidered. Peter Rowe (1987: 97) notes that "Michael Graves has eloquently described the inevitable reciprocity that occurs in an architectural design process between the act of drawing and the thinking associated with it – between 'the image' and 'the mind'". Peter Rowe (1987: 98) asks: "What is it about drawing or symbolic modeling that allows us to discover things?" And again, Graves comments:

Different scales and levels of precision reveal different qualities of solutions. Referential sketches, for instance, often have an idiosyncratic, notational quality about them. They are the "marking" of concepts and conceptual developments, rich in meaning to some but meaningless to others.

A number of current initiatives have been examining the use of sketches as research and design tools. In a competent article, Simon Unwin (2007) examines the role of drawing as an analytical tool. More recently, Katica Pedisic (2010), a PhD candidate at RMIT, writes that sketching is "a critical method in my research, in my design thinking". In fact, in discussion, many prominent

architects, some renowned for the sophistication of their digitally-animated walk-through and fly-around presentations, admit to sketching as being their preferred technique for exploring the brief and for conceptualisation. Even the study guide for an engineering course at MIT (Riskin 2008) proclaims that “Drawing and sketching—pencil to paper – is still a first means of developing problem solving your ideas and designs”.

## Conclusion

Far from relying primarily on his unquestionable intuitive genius, it was found that each project was not only based on intensive research, but also that each adopted a uniquely different approach to research. Four key observations emerged. First, history, theory, technology, analogies, precedent and previously-developed concepts were all variously investigated in search of formative ideas. Second, his research was not so much a pre-design activity as an investigation integral and congruent to conceptualisation and design development. Third, a common process in all instances was that empirical analyses, direct observations and tectonic explorations were probed, integrated, assimilated and incorporated through sketching. Fourth, good research fused with reflective insight can have a predictive function.

It can be postulated from these observations, that whenever a design challenges conventional and standard solutions and whenever it engages with issues beyond the purely programmatic, the whole project, from inception to completion, including research, design and construction, essentially constitutes an experiment. Further, the processes and impacts of such an experiment can be described (and debated) only once the town or building has been operational for some time. An inevitable conclusion is that post-rationalisation should be reconsidered and refined as a legitimate means of architectural explanation and substantiation. In addition, in spite of advances in digital representation, the value of sketching as a means of integrating research and design should not be underestimated.

## Works cited

- Baker, G. 1996. *Le Corbusier – The creative search*. New York: Van Nostrand Reinhold. London: Thames and Hudson: 15-47.
- Bartlett School of Architecture. [www.bartlett.ucl.ac.uk/research/architecture/overview](http://www.bartlett.ucl.ac.uk/research/architecture/overview) [accessed 1 June 2010].
- Gayatri, C. 2009. India’s Economy since Independence. <http://theviewspaper.net/india> [accessed 6 June 2010].
- Curtis, W. 1986. *Le Corbusier: Ideas and Form*. Oxford: Phaidon.
- Graves, M. 1981. *Le Corbusier: Selected Drawings*. London: Academy Editions.
- De la Porte, J.P. 2008. Architecture as Reliable Knowledge. Unpublished draft article.
- Groat, L. and Wang, D. 2002. *Architectural Research Methods*. New York: John Wiley.
- Dickie, J. 1978. Allah and eternity: Mosques, madrasas and tombs’. In G. Mitchell (ed.). *Architecture of the Islamic World: Its History and Social Meaning*. New York: Monacelli.
- Jencks, C. 2000. *Le Corbusier and the Continual Revolution in Architecture*. New York: Monacelli.
- Kalia, R. 2002. Who is the architect of Chandigarh? In J. Takhar (ed.). *Celebrating Chandigarh: 50 Years of*

- the Idea*. Proceedings of a conference held on 9-11 January 1999 in Chandigarh: 414-21.
- Lawson, B. 1980. *How Designers Think: The Design Process Demystified*. London: Butterworth.
- Le Corbusier. 1927. *Towards a New Architecture*. London: John Rodker.
- Le Corbusier. 1929. *The City of Tomorrow and its Planning*. London: John Rodker.
- Le Corbusier. 1958. *Modulor 2*. Cambridge, Massachusetts: MIT Press.
- Le Corbusier. 1960. *My Work*. London: Architectural Press.
- Le Corbusier, Pierre Jeanneret, et al. 1995. *Oeuvre complète*, volumes 1-8. Edited by Willy Boesiger. Basel: Birkhäuser.
- Lynch, K. 1981. *A Theory of Good City Form*. Cambridge, Massachusetts: MIT Press
- Morris, A.E.J. 1994. *History of Urban Form before the Industrial Revolution*. London: Prentice Hall.
- Papillaut, R. 2002. Temporal dimensions in the urban projects of Le Corbusier. In J. Takhar (ed.). *Celebrating Chandigarh: 50 Years of the Idea*. Proceedings of a conference held on 9-11 January 1999 in Chandigarh: 322-30.
- Pedisic, P. 2010. The act of drawing as mediating the emergence and perception of space. Current PhD theme at RMIT. [accessed 1 June 2010]
- Riskin, Noah. 2008. Drawing as Thinking: Linking Eye and Hand for Better Design. Study Guide for the Engineering Course Module Design and Manufacturing I. MIT Website [11 June 2010]
- Risselada, M. 1988. *Raumplan versus Plan Libre*. New York: Rizzoli.
- Rowe, P. 1987. *Design Thinking*. Cambridge, Massachusetts: MIT Press.
- Takhar, J. (ed.). 2002. *Celebrating Chandigarh: 50 Years of the Idea*. Proceedings of a conference held on 9-11 January 1999 in Chandigarh. Ahmedabad: Mapin.
- Tzonis, A. and Lefaivre, L. 1985. Syncretism and the critical outlook in Le Corbusier's work. In A. Tzonis (guest ed.). *Drawings from the Le Corbusier Archive. Architectural Design Profile* 60, 55 (7/8): 7-8.
- Unwin. S. 2007. Analysing architecture through drawing, *Building Research & Information*, 35 (1, February): 101 -10.

Gerald Steyn is Research Professor at the Department of Architecture of the Tshwane University of Technology. He holds B Arch and M Arch degrees from the University of the Free State and a PhD from the University of Pretoria. His academic and research interests include settlement dynamics and vernacular African architecture, with a special focus on African urbanism, affordable housing and good neighbourhoods – and, of course, Le Corbusier!