The Master Architect Series

morphogenesis.

The Indian Perspective.
The Global Context.
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FOREWORD
by Michael Webb

Around the world, architects are challenged to infuse new forms with the legacy of the past and the spirit of place. In an age of globalisation this has become a critical issue, especially in emerging nations that have embraced generic modernism in their race to catch up. It is ironic that a few Westerners – from Edwin Lutyens to Le Corbusier and Louis Kahn – showed a greater appreciation for the unique character of Indian architecture and the demands of its climate than do many native architects. Morphogenesis is a notable exception: a versatile 125-person firm that roots its work in the environment. It abstracts the vernacular with no resort to mimicry, and it achieves sustainability by an intelligent use of traditional materials and techniques.

It would be hard to overstate the importance of this achievement, and the firm’s success in overcoming the obstacles that frustrate every architect – from developers fixated on short-term profit, to a sclerotic bureaucracy and a widespread resistance to innovation. In this monograph, Morphogenesis lays out a few simple strategies that make perfect sense in social, economic and aesthetic terms. Their buildings are pragmatic, often frugal, always imaginative. They respond to climatic extremes and the well-being of their users. The portfolio includes houses and apartment towers, corporate offices and educational institutions, master plans for new cities and an ancient pilgrimage site. Each of these projects has a distinctive identity and a similar concern for practicality.

Every Asian city is confronted with a multiplicity of crises, as a tide of immigrants overwhelms an outdated infrastructure, as resources are exhausted and pollution grows, and as climate change poses an ever-greater threat. Architects like Morphogenesis must sometimes feel as though they are carrying buckets of water to extinguish a raging inferno. But the power of example is immense. By doing the right thing, this firm may inspire a new generation of architects, business and civic leaders to embrace their vision. All that’s required is a focus on the essentials; an understanding of how much can be learned from the past and reinterpreted for a fast-changing world. As a democracy with vast human and natural resources, India could become the model for its neighbours.

Michael Webb is a Los Angeles-based writer who has authored more than 20 books on architecture and design, most recently Building Community: New Apartment Architecture, and Modernist Paradise: Niemeyer House, Boyd Collection, while contributing essays to many more. He is also a regular contributor to leading journals in the United States and Europe. Growing up in London, he wrote for The Times and Country Life, before moving to the United States to direct film programs for the American Film Institute and curate a Smithsonian exhibition, Hollywood: Legend and Reality, which travelled to major American cities and Tokyo.
Morphogenesis has established itself as not only a leading architecture practice in India, but as an influential research-based firm, and a world leader in sustainable design. They aptly describe themselves as a ‘knowledge firm,’ which has research and development implications far beyond the confines of conventional architecture and is leading to a new kind of environmental response. This is not just a new typology, but an innovative conceptual basis for architecture.

Manit and Sonali Rastogi were fortunate to be studying at the world leading Architectural Association School of Architecture at a time when major theoretical developments were being pioneered. In particular one group was investigating architecture as a form of artificial life and exploring the fundamental processes of morphogenesis in nature and proposing a parallel theory in architecture. Manit and Sonali immediately understood the importance of these generative techniques and eagerly participated. Manit established himself as one of the key students in the group and his contribution to the Evolutionary Architecture exhibition in January 1995 is still widely published to illustrate this pioneering work. It is no coincidence that they subsequently called their practice Morphogenesis.

Most architects have taken the computer techniques of generative design as a method of creating exotic forms for their own sake far removed from the ethical and environmental concerns that motivated the original research. Morphogenesis has sacrificed such self-indulgent form generation to concentrate on the fundamentals of an ecologically responsible and environmentally responsive and appropriate architecture. Their skills with computer techniques are deployed as powerful tools for the control of the metrics of energy efficient design in a social and economic context.

Innovation is very difficult in the real world with naturally cautious clients and with all the risks and costs that are involved. However Morphogenesis repeatedly manages to build real buildings that make significant research-based innovations with every project – and that requires commitment. Indeed they have made a massive personal commitment to architecture as a way of life and with intelligence, determination and creativity their approach is leading to a new architecture.

Their 20-year-old practice is establishing new expectations of climatic sensitivity in a social and environmental context. Twenty years is a very short time in architecture and Morphogenesis has made very rapid progress. This book is a celebration of the substantial achievements so far and gives clear indications of what is to come and a hint of the nature of the new architecture to which Manit and Sonali are committed.

**Professor John Frazer** is acknowledged as a world leader in the domains of intelligent and interactive design, sustainable design, participatory design and computer-generated design. He is best known as the originator of the evolutionary digital design process and generative design techniques. His book *An Evolutionary Architecture* is the seminal work in the field and proposed a new model of the design process.
Sustainability: defined as the ability to endure in local conditions and thrive in its lifecycle, the projects that are planned at the firm are maintainable in their individual ecosystems. Understanding that ‘energy resources’ at most times are considered limited or depleting, the firm’s guiding principle is ‘no is more’. Constant emphasis is put on developing the practice on an approach of ‘no energy and no water’ and ideally, no waste.

There have always been two schools of thought on how to design green buildings. Some believe that buildings should be designed like an aircraft – highly engineered and hermetically sealed, to achieve a high degree of efficiency. The alternate view that Morphogenesis aligns with is that climatic specifications and socio-cultural contexts are imperative to take into consideration before designing a building. The practice believes that architecture
and urban planning play key roles in increasing the interaction between the users and their surroundings. Though project briefs are getting increasingly ‘global’, the response needs to be deeply rooted in the ‘local’.

At Morphogenesis, design solutions have an emergent quality due to the approach of looking at various questions through the lens of sustainability. The questions asked are: How do you begin to build? How do you put things together? Do you need to build this much? And how will it respond to climate? How has it been done before and what has it been done with? What will be the impact of these choices on the building as well as the environment it sits in? This examination is done across varied scales – from product, to building, to urbanism.

Given that our cities occupy a mere 2 percent of all the surface space in the world, yet humans consume a net 75 percent of the earth’s resources as per the United Nations report on World Population Prospects. There is an intrinsic need to begin to explore the possibilities of a closed-loop typology of architecture. Assuming there is no energy, no water, and no waste disposal, how does one approach design? A potential answer lies in traditional architecture which has always been green as a response to limited natural resources, especially water and energy.

The aim is to develop a sustainable design by increasing the number of comfortable hours with minimum reliance on mechanical means and mechanical loads. This is achieved by reducing energy consumption through passive systems and by creating a microclimate on site. This ensures a 10°C (50°F) reduction in perceptible temperature in the hot-dry season; augments wind movement in humid climates; enables evaporative cooling and shading in hot climates and maximises solar ingress in cold climates. Orientation of the building and optimisation of form are fundamental strategies deployed with the aim of maximising daylighting while controlling glare and heat ingress. Landscape design and horticulture selection are key design tools and play a significant role in creating environmental buffers, facilitating effective microclimates.

Some schools of thought have been pushing the concept of ‘thermal comfort’, and that ‘comfort’ is within a very narrow band of about 2 degrees, between 22°C and 24°C (71.6°F and 75.2°F) with 50 percent to 55 percent relative humidity. This necessitates buildings to be designed such that they are sealed off from their external environment. These prescriptive targets and the standard solutions to achieve this narrow comfort band are resource intensive. Morphogenesis’ position is that the comfort band is wider than the assumed 2 degrees and the aim then, is to create adaptable conditions to help widen the comfort band as much as possible, to approach zero energy resource usage. Effectively if the perceivable temperature outside is 10°C (50°F) then the viable comfort level inside works at 18°C (64.4°F) and if it is 46°C (114.8°F) outside then the comfort level could be set at around
28°C (82.4°F). By redefining what constitutes ‘comfort’ and ‘shelter’, the need to seal off the building decreases, increasing the potential of the built form to be spatially engaged with its external environment. With inspiration from history deeply ingrained in the firm’s design thinking, traditional architectural strategies and techniques are understood and incorporated within contemporary and energy efficient façade schemes that enhance performance of air conditioning and heat recovery techniques.

The design practice extends this definition of sustainability into the socio-cultural realm. Special attention is paid to detailing and vernacular methods of construction. Incorporation of local techniques of craft and construction and an inclusive approach to local materials are aimed at promoting a low carbon footprint. Inspired by traditional methods of construction, such as earthen pot insulation, earth-bermed strategy, high thermal mass walls, cooling ponds and windcatchers, this imparts a distinct identity and character to the building while tackling the affordability aspect of construction. This sensitivity to the local conditions aims to not only generate a robust and durable form, but makes a project socio-culturally sustainable, addressing the livability philosophy of the firm.

The Pearl Academy, situated outside Jaipur in the harsh and hot-dry desert climate of Rajasthan, is one of Morphogenesis’ buildings that liberally takes inspiration from regional architecture. The project aims to revisit and interpret the environmental adaptation that Rajasthan and its architectural legacy has to offer, and create an environmentally and culturally relevant project that finds its place in the historic continuum of the sustainable architecture of this desert region.

The project employs a hybrid system where it uses only part air conditioning (20 percent) and mainly cost-effective passive design strategies to cool the building. Construction materials comprise a mix of steel, glass and concrete, with local stone, cementaceous jaalis (perforated fenestrations), earthenware and other local resources. History and tradition of this region are replete with design solutions that have led to magnificent architecture and created a tapestry of rich details, which are relevant even today. Morphogenesis adapted the perforated fenestrations and the sunken stepwell (baoli). While the outdoor temperatures can reach up to 47°C (116.6°F), the indoor temperatures are maintained around 29°C (84.2°F) without the use of air conditioning. This is facilitated by evaporative cooling and microclimate creation resulting from the building morphology channeling the warm air over the waterbody, cooling it down. In the parched region of Rajasthan, the water is entirely recycled. The Pearl Academy won the Best Learning Building Award at the World Architecture Festival in Barcelona, in 2009, the first Indian practice to win a WAF award. (For a full profile, see page 23).
NET ZERO PROJECT

RENEWABLES

EFFICIENT SYSTEMS

PASSIVE DESIGN

MICROCLIMATE CREATION

ENVIRONMENTAL GAIN

Energy efficient M&E equipment
Active façade systems | HVAC | Heat recovery
& recycling | Control systems | Sensors & actuators

Optimised form | Orientation | Thermal mass | Insulation | Shading design |
Maximise daylighting | Minimise glare | Natural ventilation | Optimise views | Geothermal

Solar | Wind |
Biomass | Waste

Orientation | Morphology | Shaded spaces | Addressing urban heat island effect | Harnessing cool winds | Blocking hot winds |
Evaporative cooling | Vegetation | Xeriscape | Local materials | Waste management | Rainwater harvesting | Water reservoir design
After energy optimisation through passive means, the pertinent conservation issues that remain are addressed through renewable energy and a system design strategy that incorporates efficient construction technologies. Taking a case example of The British School (see page 131 for a full profile), the firm found inspiration in the school’s tagline, ‘An International education with an Indian soul’. Contextual awareness for the students of this international student body, which at any point comprises 50 to 60 different nationalities, became the central theme of Morphogenesis’ design. The education of sustainability and the architectural adaptation of the traditional style of this region become a culturally enriched social setting for this truly international student community.

The school is arranged around a series of courtyards with adjacent open, non-air-conditioned corridors. Passive environmental design features were particularly influential in the spatial planning of the project. Spaces have been designed to promote student engagement with the outdoors and for the students to negotiate the harsh climate in tempered ways, while they move through the day. This was deemed essential to provide the students with the desired experiential environment and opportunity to be environmentally aware. The microclimate in the courtyards is controlled with the arrangements of the built volume that shade them throughout the year and hence set the stage for outdoor activity, socio-culturally rooting the space usage in a relevant courtyard/community style. The design is replete with rain gardens, chaupals (outdoor gathering spaces), outdoor learning spaces and a large swimming pool situated in the shade of a large jaali that screens it from the south sun.

For design solutions to be indigenously tailored, there is a need for Morphogenesis to probe its potential existence in its local climatic, social, cultural and geographical context, and its success then, can only be measured by an indigenous green evaluation scheme. Notably, The British School project has been evaluated under India’s own green rating system called GRIHA, which was created to address the varied and diverse conditions that prevail in India: from multiple climatic zones to part-ventilated buildings, issues of limited resources and cultural diversity in the built form. Manit Rastogi, co-founder of Morphogenesis and Member of the advisory/founding committee of GRIHA, continues to participate actively in formulating this indigenous rating system.

While the design seed is rooted in its strong socio-cultural consciousness, the practice thrives on the approach of always optimising a project by examining it based on its first principles. For a project to be close to ‘net zero’ or ‘off the grid’, its local conditions need to be examined carefully. The office building for Infosys Campus in Nagpur is a significant model for sustainability for large-scale developments, as it is aimed at creating the world’s most energy efficient office building of that size.
Designed to achieve net zero in energy, in water, and in waste discharge to landfill, the project intends to set a model for larger developments in the future. (For a full profile, see page 49). While the campus can accommodate 65,000 people, it has been designed for 20,000, based on the carrying capacity of the land. The campus’ performance remains at net zero at an EPI (Energy Performance Index) of just 25; the challenge to achieve this benchmark at such a large scale is enormous (the current typical EPI of buildings of a similar scale is 200 and the GRIHA baseline is 140). This project has also been recognised through a published paper at the PLEA (Passive and Low Energy Architecture) Conference (2014).

Morphogenesis extends this approach of environmental sustainability into the urban realm with the Delhi Nullahs project (see page 85 for a full profile). With this advocacy project, the firm looks to increase the livability index of the national capital, by tapping into the latent infrastructural network of the city. By establishing a green and sustainable network as an alternative and democratic source of engagement, the design intent is to bring back walkability and rejuvenate the congregation spaces that make the socio-cultural fabric of the metropolis.

The team at Morphogenesis successfully implements its design ethos effectively across a project while it simultaneously focuses on increasing the project’s environmental sustainability, challenging the myth that green buildings are more expensive to build. The built form responds to the environment and a harmony of interdependence is maintained amid the two. It is precisely this very relationship that will not only create an architecture that is truly sustainable, but which will also build communities that are once again interconnected with nature.
Morphogenesis’ evolution and refinement in passive design techniques over time show through the reducing EPI figures achieved with successive projects. Learnings from the partly air-conditioned (hybrid) Pearl Academy have been implemented in subsequent projects, culminating in an EPI of 25 for the fully air-conditioned Infosys Campus, on par with Pearl Academy and a reduction of over 70 percent from the GRIHA baseline of 140 kWh/sqm/yr.

**GRIHA Baseline EPI**

<table>
<thead>
<tr>
<th>Building</th>
<th>Pearl Academy</th>
<th>India Glycols Headquarters</th>
<th>GYS Vision</th>
<th>Zydus Headquarters</th>
<th>Infosys Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPI</td>
<td>140</td>
<td>60</td>
<td>55</td>
<td>50</td>
<td>25</td>
</tr>
</tbody>
</table>

**2008 to Date EPI Reduction**

EPI: Energy Performance Index on primary energy consumption (unit: kWh/sqm/yr)
Pearl Academy is an attempt to develop an ‘architecture of somewhere’ at a time when there is a paradigm shift in architecture towards a landscape sprinkled with identity-less models of ‘generic modernism’.

Looking at the project through the lens of sustainability, passive features lend themselves to the identity of Pearl.

This project in Jaipur is geared towards creating an environmentally responsive, passive habitat. A radical fusion of traditional and contemporary architecture, the institute creates interactive spaces for a creative student body to work in multifunctional zones that blend the indoors with the outdoors seamlessly.

The introverted building design compensates for the unloved industrial nature of the site’s surroundings. This building takes an optimised rectangular form derived from Jaipur’s traditional building morphology, which is typically high density, opaque exteriors with more fluid interiors. Despite its compact, rectilinear external form, Pearl’s internal courtyard shapes provide a sense of the perpetual, infinite – a continuous and fluid space with no end; like a Mobius strip.

The architecture is a confluence of modern adaptations of traditional Indo-Islamic architectural elements and passive-cooling strategies commonly used in Rajasthan’s desert climate, such as self-shading courtyards, water bodies, baolis and jaalis (typically made of stone) to negotiate the large differential between internal and external temperatures.
The building is protected from the environment by a double skin, which is derived from a traditional building element, the jaali, which is prevalent in Rajasthani architecture. The double skin acts as a thermal buffer between the building and its surroundings. The density of the perforated outer skin has been derived using shadow analysis based on orientation of the façades. The outer skin sits 1.2 meters (4 feet) away from the building and reduces direct heat gain through articulated fenestrations, yet allows for diffused daylight. The jaali thus, serves the function of three filters – air, light and privacy.
Traditionally inspired low-cost methods of roof insulation have been used to cut down heat absorption. Inverted matkas (earthen pots) are laid across the surface, the space between filled with sand and bricks and then cast over with a thin, binding layer of concrete.
The underbelly, derived from a traditional baoli, employs earth sheltering, thermal banking and evaporative cooling to modulate surrounding temperatures. Temperature and climate analysis for this region shows that at a depth of 3 metres (9.8 feet) the ground temperature equals the average temperature of the region, which is about 25°C (77°F). This, along with evaporative cooling, achieves stable temperatures of about 27°C (81°F) inside the structure without the use of air conditioning, even when outside temperatures are up to 20°C (68°F) higher.

The space serves as a large student recreation and exhibition zone with a cafeteria and a performance area with space for fashion shows, and forms the anchor for the entire project. Manipulation of the program enabled the elimination of a complete built-up floor, as the same functions are now designed to be carried out in the underbelly.
Daylight performance analysis of the fluid self-shading courtyards
The Pearl Academy is an exemplar of an inclusive architecture that is socio-culturally relevant and is inspired by local heritage, while positioning itself within the contemporary cultural and architectural paradigm.
The bespoke quality of craft, emergent from skill and handed-down traditions is a culture that speaks volumes about luxury. This luxury primarily comes from the dexterity and beauty of spatial configurations, lending the space an experiential quality.

Artisan House represents this vision of 'the handmade' and expresses it through the incorporation of craft, material, method and design.

A country as diverse as India is symbolised by the plurality of its art and culture, yet with the changing paradigm there is a need to conserve these symbols that are under constant threat of neglect. Morphogenesis works towards re-establishing a patronage for these artisanal skills that contribute greatly towards cultural sustainability.
West elevation

Sequential sections through the striated volume

Section A

Section B

Section C

Section D

Section E

Section F

Section G

Section H
The design exploits the undulating terrain on which the project is located and uses it to create split-levels. These levels are instrumental in segregating functions. While the private spaces are placed in the earth-banked lower level, spaces for public gatherings are designated to the upper level. A very strong relationship between the landscape and the residence has been established, where each indoor space has a unique outdoor space that extends its specific program. The private living is organised around a central courtyard which has a temple centrally placed in it, imbuing a spiritual omnipresence.
1. Entry
2. Guard room
3. Driveway
4. Formal entry
5. Drop-off
6. Ramp
7. Parking
8. Informal entry
9. Service block
10. Tennis court
11. Outdoor seating
12. Kitchen garden
13. Plunge pool
14. Pool
15. Water body
16. Landscape rotating steps
17. Gazebo
18. Front lawn
19. Feature wall
20. Service area
21. Housekeeping staff block
This residence has a strong overriding graphic language of striation, which is the dominant organising principle of the site. This banding pattern sweeps across the built volume, to create various zones and retain scale within this very large house. Each band enables a distinctive treatment of the planes, surfaces and the volumes they subtend. It expresses itself in elevation as a series of layered walls, an artistic juxtaposition of vertical planes. In complete contrast to these modern planes and surfaces, the detailing is replete with traditional material and craft-based nuances. There is stone craft in one zone, metal craft in another, textiles of a certain kind in the next. The strategy of striation allows the bringing together of distinct crafts and over 50 materials without impinging on the architectural sensibility and destroying a cohesive narrative.
This house represents luxury that is redefined – luxury reminiscent of the past, of India being the richest repository of handcraft available anywhere in the world; luxury in terms of freedom with experimentation that both Morphogenesis and the client embraced; and finally, the luxury of sequential exposures and experiences akin to the unfolding of space after space in a museum.
The DAG projects are a magnificent showcase of the creative freedom of Morphogenesis’ design expression for the nuances of a high-end retail paradigm and gallery display setting for some the best contemporary art in India. Both the Delhi and Mumbai spaces feature multi-functional and multi-dimensional areas, including library, an area for public dissemination of artworks, storage, display and offices. The gallerist holds one of the world’s largest collections of Indian modernist art, and the DAG spaces display and store around 30,000 paintings across the two sites.

The innovative design for both DAG sites is a sophisticated, calm and introspective space that frames spatial compositions distinctively into a series of reconfigurable rooms with a set of sliding panels and moveable fretted screens designed for maximum exposure and circulation of a quantum of artworks. Handcrafted metal jaalis with trelliswork augment the design with a quintessentially Indian identity. The sliding panel system enables the works to be stacked and mounted to the wall in various arrangements, allowing the gallerist the high level of storage required without compromising aesthetics.

Conceptually, the interplay of the panels creates dynamism, which expresses itself by way of a constantly transforming architecture.
A reconfigurable, dynamic performance space of 14 movable and 3 fixed panels that aid in the positioning of each artwork in a secluded or collective environment, depending on the requirement.
This creates an event space and an experience that can display the art in an innovative, yet elegant manner. The space in Delhi also features a full wall-sized multimedia projection screen at the entrance façade, maximising the interface between the gallery and passerby; by exhibiting the gallery collection, the pedagogy of the artist and information on the artworks themselves. Hence, the screen on the front façade virtually extends the gallery space and art becomes inclusive.
The branch at DAG Mumbai is a four-level, century-old structure sitting in a lively and historic precinct that’s undergoing strong cultural revival. Years of terrible neglect and significant damage to this very cramped, former warehouse/repair shop building saw this project emerge and significantly transform into an impressive retrofit and adaptive reuse of splendid Colonial-era architecture.
Structurally the building required extensive renovation. Investigative design processes confirmed some of the widely used local Colonial heritage motifs for rhythmic patterns in metal and woodwork, including the exterior façade’s original wrought-iron and stucco features. These elements have been interwoven here to retain heritage value but without anachronistic imitation. DAG Mumbai could be a defining example for rejuvenating other derelict historic districts in urban India.
This outstanding monograph delves into an exciting selection of esteemed works by Morphogenesis, one of India's most creative architecture and design firms, and a world-leader in net zero energy and sustainable design. Another successful addition to IMAGES' Master Architect Series, this richly illustrated book combines stunning imagery with comprehensive studies outlining the firm's strong philosophical discourse across a vast range of typologies: residential; institutional; commercial; hospitality; offices; interiors; public; and master planning.

Morphogenesis reinterprets India's architectural roots and consistently employs passive design solutions for a unique contextual language. The Morphogenesis journey is a reflection of a contemporary Indian perspective within the global context, incorporating an inspired, forward-thinking vision while respectfully referencing the spirit of traditional Indian subcontinental architecture in innovative forms. This is a must-have book for those looking to understand work at the vanguard of sustainable architecture.

The Master Architect Series
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