Office building in India
The ecologically-friendly and culturally nuanced building of Development Alternative in New Delhi includes molded terracotta tiles that form a jali (patterned screen) feature common to traditional buildings in northern India. The tiles are filled with insulating vermiculite plaster and some host recycled mirror fragments that glint sunlight and enhance the dimensional effect.

### Alternatives in urban architecture

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Office building in India
Alternatives in urban architecture

By Hans-Rudolf Schalcher, Head of the Technical Competence Center and member of the Management Board of the Holcim Foundation
This is the fourth volume in our series of architectural monographs on buildings that exemplify sustainable construction. Similar to the project discussed in the previous volume, *Community Center in South Africa – Tsoga Resource Center*, which proposes a model for building in poor African suburbs and towns, Development Alternatives world headquarters in New Delhi also proposes a low-cost model for building in the local context – but here the context is urban India. Accordingly, the scale is larger and the execution more sophisticated. Tsoga offers a model for socioeconomic development in poor suburbs of developing countries, seeking to meet basic needs, whereas Development Alternatives world headquarters offers a model for urban development in transitional or emerging economies seeking to improve environmental performance.

Globalization, industrialization, and emerging affluence of broad population segments in India are driving a construction boom that is expected to double the national building stock in the next two decades. During this boom, the energy expended in the production of construction materials for these buildings will be of significance in addition to the considerable energy consumed by the operation of the buildings themselves. Thus, gray energy, or embodied energy, which is often disregarded as a one-time expense, deserves critical attention. This building shows readily adapted ways to reduce the embodied energy in urban buildings by about a third.

Development Alternatives is an NGO committed to spreading environmentally appropriate technology and fostering socioeconomic equity. The client and the architects jointly sought alternative means of achieving these aims through the project. The building illustrates seldom-seen yet reasonable ways of reducing embodied energy in buildings, equitably distributing wealth through the construction project, updating vernacular
“Today we are more aware of global limits, so we question whether the priorities of consumption, carbon, comfort, and commercialization need to be rebalanced.”
materials and forms, and curtailing energy consumption and CO₂ emissions. The architects refused to accept even the best available technology for the building’s air-conditioning system; they worked with specialists to design a hybrid system estimated to be at least thirty percent more efficient than anything on the market. Innovators don’t just know when there is a better way; they are clever enough to find it, and determined enough to build it.

Over the past forty to fifty years, the construction industry has become highly industrialized, using ever more resource-intensive materials and processes. The developments made during these years were impressive improvements for convenience and commercialization, with little regard for resource consumption or carbon emissions. Today we are more aware of global limits, so we question whether the priorities of consumption, carbon, comfort, and commercialization need to be rebalanced. Seeking this balance is precisely what the client and architect do in this project.

The client, Development Alternatives, makes the case for a way of building using natural, low-CO₂ materials and for sensibly adjusting expectations of indoor thermal comfort in buildings, for the sake of planetary health. Architect Ashok Lall draws on building traditions that industrialization and commercialization has neglected. He seeks not to revive tradition, but to redefine old methods in the contemporary context. He embraces tradition not because of the past, but for the sake of the future.
Sustainable construction

- Quantum change and transferability
- Ethical standards and social equity
- Ecological quality and energy conservation
- Economic performance and compatibility
- Contextual response and aesthetic impact
Sustainable development and architecture are complex subjects intertwined with many other complex issues. To make sustainable construction easier to understand, evaluate, and apply, the Holcim Foundation developed a five-point definition. These five so-called “target issues” serve as yardsticks to measure the degree to which a building contributes to sustainable development. Three of the five target issues align with the primary goals of the Rio Agenda: balanced environmental, social, and economic performance. A further target issue applies specifically to building – the creation of good buildings, neighborhoods, towns, and cities. The final target issue recognizes the need for significant advancements that can be applied on a broad scale. These five target issues are explained in detail and illustrated at www.holcimfoundation.org/target. Following is a summary of the five criteria and how Development Alternatives world headquarters meets them.
Quantum change and transferability

Significant improvements and advancements in construction practice, if applied on a broad scale, can contribute much toward global sustainability. Important advances must be recognized as such and repeatedly applied to achieve significant change. Practices and ideas that transfer best are those which are affordable, simple, and broadly applicable.

The design, materials, and techniques of Development Alternatives world headquarters demonstrate a fundamental alternative for the construction of comfortable, green, and affordable buildings of many types.

Nearly all interior and exterior walls are built of cement-stabilized compressed-earth block and cement-stabilized fly-ash lime-gypsum block, the manufacture of which recycles plentiful local materials in processes that use local labor and low energy. The project tests innovative, specially designed elements and components such as a hybrid air-handling unit that incorporates available components in a new way to achieve great energy savings.

The project points toward the potential of efficient industrialized production of simple, reliable, low-energy building materials that, when broadly adopted, will help curtail the massive energy consumption and CO₂ emissions.

By offering its R&D as the first step of commercialization, the project is a catalyst for the mass production of green building components.
Sustainable buildings conserve finite material and energy resources and minimize greenhouse gas emissions. Good built environments are healthful for humans, animals, and plants. Green buildings help keep the natural environment and ecosystems healthy by reducing waste, controlling pollution, and treating land, air, and water as precious resources.

Ecological quality and energy conservation

Efficiently built in reinforced concrete and masonry, Development Alternatives world headquarters uses less than half the reinforcing steel used in comparable structures of conventional design. The approach holds significant potential for reducing resource consumption and greenhouse-gas emissions.

The building uses predominantly natural, recycled, renewable, and reusable materials embodying low process energy. Highly energy-intensive materials like aluminum are shunned; others, such as glass and steel, are used frugally.

Eighty percent (by volume) of the building materials were sourced within 500 kilometers of the site, thus holding down CO₂ emissions of transport.

All rainwater that falls on the site is used to recharge the groundwater. All wastewater is recycled, treated on site and used for irrigation and flushing toilets.

Hybrid air-handling units integrate evaporative cooling and refrigerant-based cooling to reduce energy consumption for air conditioning by thirty percent, and to reduce water consumption.
In many communities, sustainable construction principally involves supplying urgent basic needs such as shelter, water, schools, and access to goods, services, and medical care. Towns and buildings must respond to emotional and psychological needs of people by providing stimulating environments, raising awareness of important values, inspiring the human spirit, and bonding society. Sustainable construction also includes fair and respectful treatment of everyone involved during the design, construction, use, and recycling of buildings and cities.

The ground floor and the outdoor areas of Development Alternatives world headquarters are open to the public, inviting public participation in the programs and activities of the organization. The entire building is barrier-free.

The project was conducted in a structured way in consultation with the client and users. Consensus was established at each stage of design development, capped by a peer review by architects and environmentalists.

All workspaces enjoy an equal level of comfort and view. Each working group is given its own sense of identity and a feeling of belonging to and interacting with a larger community.

The project used simple local materials and local labor to direct money into the pockets of local workers and local construction trade. Traditional construction skills and fine craftsmanship were integral to the design.

During construction, adequate accommodation was provided for the migrant workers who lived on the site, including daycare for their children.
Every building must be financially feasible to build, operate, maintain, and ultimately remove. Sustainable buildings can help balance the distribution of wealth by supporting the disadvantaged. This can be achieved by establishing long-term new bases for livelihoods, stimulating local economic activity, and paving the way to broader economic integration.

The environmentally friendly construction techniques and mechanical systems used in the building cost no more than their conventional energy-intensive counterparts.

Economical local materials, simple technology, and local labor were employed to keep construction costs low.

Maintenance costs are minimized by using unfinished, durable, natural materials selected to age with grace.

Operating cost is kept low by natural lighting of all workspaces and a flexible and efficient hybrid cooling system.

The project illustrates traditional, environmentally efficient construction materials and systems that can be economically developed for low-energy mass production and adopted by the mainstream building industry, especially in developing countries.
Sustainable architecture is durable and adaptable. It provides an attractive, comfortable, and functional indoor environment. It enhances its surroundings, fitting functionally and aesthetically into the community setting. It provides culturally relevant indoor and outdoor spaces.

Responding to its physical setting, Development Alternatives world headquarters forms a visual anchor at the end of the city street on one side and shows reverence to the calm forest on the other. The significance of the historic city forest as an ecological asset is heightened by how the building embraces the forest.

The work of architecture is a symphony in masonry, with nearly a dozen types of brick, block, and stone used in a variety of patterns to create walls, columns, arches, domes, floors, and stairs – orchestrated to create a harmonious whole that delights the senses.

The architecture breathes the same pioneering spirit and uses many of the architectural forms of the building formerly on this site, thus recalling the landmark which it replaced.

The building combines modern technology with forms, materials, and elements of traditional Indian architecture to exemplify how regional design and simple means can adequately and durably meet the needs of most buildings in contemporary cities.

The building design expresses Development Alternatives’ concern for people and the environment through the use of natural materials, and by cultivating a stimulating and lively workplace.
Development Alternatives
world headquarters
By Daniel Wentz
This building is the world headquarters of Development Alternatives – two words that describe the structure perfectly, because it is designed to demonstrate alternatives for achieving sustainable urban development.

Development Alternatives (DA) was established in 1983 under the leadership of Dr. Ashok Khosla, a physicist and expert in environmental affairs and development, who left a career at the United Nations to construct an equitable and sustainable model for social and economic development in India. DA evolved into a nongovernmental organization of world renown, one that promotes commercially viable and environmentally responsible technology and establishes services that help predominantly poor people create sustainable livelihoods and sustainable habitats for themselves. Today DA employs over three hundred people.

In 1985 the young organization acquired a 3,316-square-meter parcel of land in Qutab Institutional Area on the fringe of a beautiful forest in New Delhi. Neeraj Manchanda, a recent graduate of the New Delhi School of Planning and Architecture, and George Varughese, a young civil engineer, began work on DA’s first building. Resources were limited, so the designers used mud as the main building material, the cheapest available. Combining an ancient construction method with modern engineering, thick walls and domes made of compressed-earth block took shape, and the building was completed in 1988. The experimental structure proved that the alternative construction system was not only feasible but could
With walls of cement-stabilized compressed-earth block and fly-ash block, the new building is expected to last at least five times longer than its predecessor, which was built of non-stabilized compressed-earth block.

produce beautiful architecture. Experience with this and other buildings led to the development of stabilized compressed-earth block, which today is proven technology. With its spiritual aura, unique formal vocabulary, and harmony with nature, the building became a destination for architecture students, and a distinctive icon that represented Development Alternatives to the world.

During its twenty-year lifespan, the building shell, made of non-stabilized earth blocks with exterior plaster, suffered substantial weathering. Temperature swings and wet-dry cycles caused significant expansion, contraction, and cracking, but the building remained serviceable. The problem was that it could accommodate only about fifty occupants, and DA had outgrown it.
Preserve, expand, or replace?

By 2006, DA needed space for 150 to 200 occupants, and was forced to consider its options, which were to (1) demolish all or parts of the building and build anew, (2) expand the building upwards or laterally, or (3) preserve the building and continue to use it, and find additional office space elsewhere.

A choice among these alternatives is essential to sustainable construction because it involves the construction, demolition, adaptation, and use of buildings – four energy-intensive activities with economic, environmental, and social ramifications. It was impossible for DA to add floors to the old building because the structural system would not bear the additional load, and it was impossible to meet DA’s needs by expanding laterally because the site was too small. Thus the question was whether to replace the building or to preserve it and look for space elsewhere.
The new building was designed to fully utilize the site.

Speaking for preservation were the cultural and aesthetic value of the building, continued use of the energy embodied in the structure, and avoidance of carbon emissions released during fabrication and installation of materials that would be required for a new building. Speaking for demolition and replacement were the condition of the building, the opportunity for intensive utilization of the site (which was large enough to meet DA’s requirements), and the high energy efficiency, better function, and long service life that a new building could offer. Ultimately, an economic fact was decisive: DA owned the site and could not afford to buy another within reasonable proximity to the city center. Weighing these considerations, DA decided to demolish and replace the building, although the loss would be painful. DA commissioned Ashok B. Lall Architects for the project.
Consultative and collaborative design process

The architects consulted with the entire staff of Development Alternatives in a structured way to arrive at a consensus on needs and aspirations, project objectives, and the design brief. The future occupants of the building expressed great concern for how the building would affect people, nature, and the environment. They wanted the building to provide a palpable experience of nature. The outdoors should be an extension of the indoors. Flora and fauna were to be welcomed on the grounds. Surfaces should be matt and natural, not glossy. The human hand should be visible in the building surfaces. There should be many different kinds of place. The staff wanted privacy and freedom in the work environment, yet awareness of others’ presence at work. The building should be equally welcoming and comfortable for rural and urban visitors.

Considering the high costs of installing and operating air-conditioning equipment, and seeking to reduce the ecological footprint of the building and lower energy consumption, the DA staff volunteered to accept a maximum indoor temperature of 28° Celsius (30° on exceptional days) at 60 percent relative humidity instead of the industry norm of 24°. This substantially reduced cooling loads, and allowed downsizing of the cooling system and a significant reduction of electrical consumption. Indoor temperatures this high are generally unacceptable in many countries.

Staff also agreed that circulation areas need not be cooled directly, rather by overspill; that toilet rooms, stairwells, and service spaces could be ventilated naturally; that the cafeteria could be cooled with an evaporative cooling system; and that variation of indoor lighting levels, temperature, and air movement would be acceptable. Thus, rather than simply adopt international standards, the staff was willing to consider an altered view of comfort and to adapt their lifestyle in favor of sustainability.
Once the broader objectives were agreed upon, structured consultation began. The architects met with technical groups to brainstorm and consider materials and systems for the building. This process was lengthy, requiring many iterations. It cannot be used for fast-track projects. Consensus was reached at each stage of design development, and after review by a peer group of architects and environmentalists, the design was largely finalized. TARA Nirman Kendra (Technology and Action for Rural Advancement), the construction and engineering arm of DA, was an important partner during this process and during construction.

It was not always possible to compare precise costs and benefits of various options, so decisions were made collectively, using rough assessments. An important decision was to span spaces with vaulted precast-concrete deck elements and hollow domes. This construction method requires about twenty percent less embodied energy than standard reinforced concrete, at roughly the same cost.

Once the system of construction was substantially determined, a small trial structure was built on the grounds of TARA Nirman Kendra and carefully examined. Contractors invited to bid on the project attended a pre-bid meeting at which they could inspect the structure to better understand the construction. The final details had not yet been resolved. Credit goes to the contractors who contributed greatly to the resolution of all technical problems despite receiving less-than-full compensation for their work. The building could not have been completed without their generous support. DA, as the client, supported the on-site experimentation and helped make technical and economic decisions based on an overall understanding of the project objectives.
The client and architects decided that the new building should carry on the spirit and evoke the memory of the original one, which it does in several ways. Forms and elements of the new building recall those of the old – domed lobby, vaulted ceilings, central courtyard. The old seminar room, circular, sunken, and covered with a prominent dome, is reborn in the same form and location. Even a tree stands on axis in front of the main entrance, as at the previous building, urging respect for nature. The new building, standing on the same site, turned at the same 45° angle, literally is raised from the dust of the old one – the original earthen blocks were reclaimed to make new blocks. Set in the city, bold and autonomous like its predecessor, the building is a dramatic reassessment of the possibilities of construction. It shares the same pioneering spirit; with a language rooted
in local tradition, it carries forward the experiments in sustainable and affordable construction technology to meet the needs of rapidly urbanizing India. The new building is evolutionary, not a break from the past. It brings DA forward into a new era. With time, it might even become a new icon.

The new building is of course also very different from the old one. With 4,500 square meters of useable area instead of 1,000, and six stories instead of one and a half, it is four and a half times larger. It fully utilizes the maximum permissible floor area of the site, and includes underground parking. It is more efficient in utilization of space, materials, and energy. It is built with a degree of technical sophistication appropriate for contemporary cities, and it promises flexible service for many decades to come.
The building establishes a visual termination of the street. This happens almost by default, because the building is aligned with the street, which ends in a cul-de-sac at the site. From this vantage point, the building presents itself obliquely. The context is urban, but the character of the site is atypical; the parcel abuts forest on two sides, and is at the end of a dead-end street in a neighborhood of large free-standing buildings. The site is almost flat, gently rising about 1.2 meters from the street to the forest. Most users of the building arrive by bus; about a quarter arrive by car, motorcycle, or bicycle.

Entering the building, after passing through the entrance lobby, one discovers a shaded courtyard, like those in old Indian palaces, or traditional mansions. In the courtyard is sky above, pools of water below, and the sound of trickling water gently echoing all around. Everything gathers around this courtyard. It is not a place of activity, like a city square; it is a place of contemplation and communion.

A variety of spaces are arranged around the courtyard: meeting rooms, offices, corridors, stairs, terraces. Many appear as a surprise. The spaces are visually connected, vertically and horizontally, to other spaces across the courtyard, blurring the barrier between inside and out. The interplay of curvilinear and rectilinear surfaces and forms in both vertical and horizontal planes gives the building visual and spatial diversity, although not the free plasticity of its predecessor.

Beyond the courtyard, one finds the cafeteria, the further side of which opens onto an amphitheater and paved gardens. The backdrop is the perimeter fence, and the forest beyond. Also to the southwest is the crèche, or daycare facility, connected to an outdoor playground.
The ground floor is open to the public, who visit the shop and use DA’s resource center. The floorplan presents several paths for exploration. One can ascend from the amphitheater and from the cafeteria garden, and cross the bridge from the middle wing to the curved wing, or ascend further to the terrace above the conference room, and eventually reach the yoga terrace outside the gym, where one is visually immersed in a forest of green – a nature reserve extending to the horizon.

Interaction with nature is central to the design. The rhythm of the seasons and the change of light throughout the day are part of an invigorating experience of life in the building. The building volume is modulated in response to the climate – shading against the sun in summer, welcoming it in winter, and capturing the monsoon breezes. The design of each facade is different, especially the fenestration, in response to solar orientation and view. The windows in the west facade are blinkered with prism-shaped protrusions that block the afternoon summer sun while permitting views of the forest. Vines climb the pergolas and east and west walls. Inset clay pots offer nesting places, inviting bees, parrots, and squirrels from the forest. The shading grills with planters and daylight reflectors on the north and south sides moderate the summer sun and intense light. Balconies and verandas not only shade windows below, but mediate between indoors and outdoors.

The unified palette of materials is woven into a variety of textures, colors, and patterns. Most materials are hand-wrought by skilled craftspeople. The materials and the spatial configuration of the building carry on local tradition, especially the architecture of forts and palaces – with courtyards and terraces, screens and balconies, pools and pavilions – that evolved in response to the climate. The building fabric delights the eye and produces
subtle aromas that change with the seasons and with the wetting of rain. The building could well last a hundred years, and the materials will mellow with age and weathering.

The baoli is a traditional architectural device in northern India, a plains region where water is found typically ten to fifteen meters below the ground surface. It is a long, subterranean stairwell, punctuated with cool resting places, and leading to the water, which was fetched for drinking, bathing, and cooking. The baoli at the DA building – a cool, shaded sitting place – is a metaphor of this beautiful device, and an example of the wide range of spaces the building offers. It is circular instead of longitudinal, with loosely concentric steps descending toward a symbolic pool of water at the center. The cylindrical room is lighted solely from above by a symmetrical arrangement of ten clerestory windows and an oculus, which is the entire domed roof itself, woven from bamboo stalks. The symmetry of apertures for this domed cylinder is more perfect even than at the Pantheon, which is violated by its door. The semi-subterranean baoli is entered from the basement.

Development Alternatives is a responsive and adaptive organization comprising several divisions and many departments. The interior layout of the building accommodates this diversity by providing flexible spaces. The environmental control systems integrated into the building allow users to independently vary the size of spaces and to control the indoor climate of each wing.
Low gray energy

Although building codes do not yet prescribe requirements for conserving gray energy, the architects paid careful attention to the energy consumed by the materials and construction methods – from choice of structural system to wall assemblies, finishes, and mechanical systems. They gave first preference to recycled or rapidly renewable materials and second preference to natural, locally sourced materials requiring little processing energy. When they used materials with high embodied energy such as brick, cement, steel, and glass, they used them efficiently and only where essential.

Ninety percent of the interior and exterior walls are made of cement-stabilized compressed-earth blocks or cement-stabilized fly-ash lime-gypsum blocks. The few 115mm-thick interior walls are reinforced with steel wire laid in every fourth mortar course. Exterior masonry cavity walls are anchored with PVC ties. The earth removed from the site after the demolition of the original building was recycled into compressed earth block using simple machinery. The fly-ash blocks used in the building were made using fly-ash from a local power plant. Nearly all masonry and architectural concrete is fair faced.

Vaulted precast-concrete deck elements are used to span most spaces. Five-meter spacing between columns makes for flexible office spaces while reducing steel consumption. The vaulted elements were precast on site using simple forms, and raised into place by chain and tackle. No crane was used on the site, primarily due to cost. Vaults are bridged from crown to crown with four-centimeter-thick sandstone slabs, in the traditional way. Some rooms are spanned by shallow masonry domes supported by reinforced concrete frames. Using these construction methods, the consumption of steel in a typical bay of the superstructure
External wall section:
1 Vaulted precast reinforced-concrete deck element
2 Kota stone floor finish with 50 mm budhpur stone spanning
3 Fly-ash cement blocks, expanded polystyrene (industrial waste), and compressed earth block
4 Teak wooden window frame and shutters.
5 Broken ceramic tile flooring (scrap) and 40 mm polyurethane insulation
6 Concrete shelf
7 Meranti wood frame
8 Daylight reflector
9 Planter
of the building works out to 28.4 kilograms per square meter of floor area, compared to an average of 50 to 60 kilograms per square meter for conventional multistory buildings with spans of 7.5 to 8 meters.

Floors are unpolished granite and sandstone, quarried in north India. The flooring pattern uses large and small flags to minimize waste and to incorporate large slabs. Doors and windows are teak, harvested from certified managed plantations. Pergolas are made of poplar and eucalyptus poles and split bamboo, except for the entrance pergola, made of meranti. The teak is finished with linseed oil, and the pergola timbers will be allowed to bleach naturally. The terracotta screen elements and perforated concrete panels for shading were made using simple machinery. Roof terraces are finished in a random mosaic pattern of broken white tiles bought as waste from factory yards. Planters are installed along the edges of some terraces. Green roofs were not used because maintenance was considered too great. The expanded polystyrene used to insulate cavity walls is factory waste. Broken pieces of waste mirror glass are set in certain shadowed surfaces for dramatic effect – for a sparkle of delight.

Many architects who think of modern urban architecture automatically think of glass and aluminum curtain walls for the envelope, without considering that the production of these materials is extremely energy intensive and emits significant CO₂. Measured by unit weight, aluminum consumes more energy in production than any other common building material, yet it has become the architect’s subconscious choice for doors, windows, thresholds, flashings, and hardware. Lall admits that aluminum has its place when used very efficiently, but to reduce gray energy he takes the general position that “we can do without it.” The manufacture of aluminum releases CO₂, whereas the growth of trees and use of wood in
buildings sequesters it. Wood is often an adequate substitute for aluminum, although the performance in not equal in every respect.

The other chief material of the curtain wall is glass – large sheets of thick, strengthened plate glass, without which modern architecture is unthinkable. Lall uses small panes of five-millimeter glass for the windows of the DA building – half as thick, or a third as thick, as the popular structural glazing. The reduction of gray energy corresponds roughly to the reduction of glass thickness.
Air conditioning accounts for approximately seventy percent of the electricity used in new commercial office buildings in India; therefore the most effective way to reduce electrical consumption is to reduce the cooling load and to use efficient cooling systems. Passive design is the best means of reducing heat gain, and the building volumes and envelope use this strategy. The approach Lall uses to control thermal gain is borrowed from vernacular architecture. First, he considers the building envelope opaque, then he positions apertures for light, ventilation, and view. No more than twenty percent of the envelope is glazed. Windows are shaded during warm seasons. Those facing east and west, which take the brunt of the morning and afternoon sun, are kept small and shaded by sunscreens or by the building volume itself.

Three types of glazing are used in the building: (1) fixed insulating glass panels with a 16mm air space, (2) operable windows with insulating glass with a 16mm air space, and (3) windows consisting of a fixed single-pane outer panel and an operable inner sash, with an adjustable venetian blind in between. Double-glazed panels are simply made with an air space, not factory-made sealed units with a vacuum or argon gas. They are effective enough and affordable. The glass is plain, with no low-E coating or selective radiation transmission. The reasoning is that if one reduces the glass area, ensures shading against direct solar radiation, and substantially reduces conduction by adding a second layer of glass, the performance will be within ten percent of that of high-performance glazing systems that cost twice as much. Adequate thermal performance can cost much less.

Of course the entire building envelope is insulated. Exterior walls are designed for optimal passive thermal performance, minimizing indoor heat gain while allowing efficient dissipation of heat stored in the
masonry. Thermal gain could be further reduced by adding more insulation, but this would hinder heat dissipation when the weather turns mild. The trick is to build thermal mass into the envelope and protect it with a moderate amount of insulation. Vines trained on many facades shade the building to reduce heat gain. Roof surfaces are finished in white tile to reflect instead of absorb thermal energy.

The perception of coolness has a psychological component too. Shade, indirect or filtered daylight, the presence of greenery, and the sight and sound of water enhance the feeling of coolness. The three-story trickle fountain in the courtyard not only moderates the air temperature, it is a very effective suggestive device that supports the perception of comfort.
Once the cooling load has been minimized by passive means, less mechanical cooling is needed to bring down the indoor temperature into the comfort zone. The most efficient air-conditioning chillers are water-cooled units in which the evaporation of water transfers heat into the atmosphere. These are suitable for large central systems, but unsuitable for this building, which is designed for decentralized operation and control. Another drawback of these systems is that they consume substantial amounts of soft water. Air-cooled systems on the market offer the benefit of modularity but they are inefficient during high summer.

Lall thought it worthwhile to investigate a fundamental alternative – a hybrid system that could offer the best of both worlds. In the hot dry season the system would use direct and indirect evaporative cooling, and in the humid season refrigerant cooling. No such unit existed on the Indian market, so Lall worked with air-conditioning consultants to develop a prototype. The specialists configured the system and sized the components, and Lall’s office arranged the components into a compact physical unit, housed to suit the architecture.
Experimental design such as this is unthinkable without the client’s consent. The design concept was promising, and the idea suited DA perfectly, except for one problem: there was no time or money for full-fledged trials and product development. The architects therefore chose a practical approach. The consultants worked with a small shop to fabricate a test prototype, which was installed at the trial structure on the premises of Tara Nirman Kendra and tested for two weeks. A control unit was installed that could automatically adjust air-handling levels and switch the mode of the hybrid unit, evaporative cooling being the base mode.

Measurement equipment was not highly sophisticated, but what Lall calls “rough and ready.” Trial-and-error testing showed that the system was reliable and promised adequate capacity and higher efficiency, although...
exact numbers were not calculated. The design was tweaked, and the final units were fabricated and installed in the building.

The performance of this experimental system can be ascertained only after two annual cycles of operation. The architects estimate that the system is thirty to fifty percent more efficient than conventional systems. If such systems would be developed and nationally commercialized as substitutes for refrigerant systems, the energy savings would be colossal. But the trade has not yet developed such a hybrid unit as a commercial

Displacement cooling requires additional vertical ductwork but delivers higher energy efficiency. In the DA building, U-shaped concrete columns house the vertical ducts.
product. The concept is not patented by Lall; air-conditioning manufacturers are invited to develop the technology.

Lall used hybrid cooling throughout the building except in the conference hall, where an experimental approach would be too risky. This space is cooled by a dedicated conventional variable-flow refrigerant system.

Research shows that displacement cooling – in which cool air is introduced at the floor and return air is collected at the ceiling – reduces energy consumption on two counts. The air need be cooled only to 19° Celsius or 20° (as opposed to 14° in overhead-feed systems) because the cool air does not mix as much with the warm air, which naturally rises. Also due to buoyancy, the energy required to move the air through the distribution circuit is reduced. Displacement cooling is about 15 percent more energy efficient than conventional air-distribution systems. At the DA building, the air-distribution channels are integrated into the structural system. U-columns conduct cool air down to the floor, and overhead hollow spaces between the vaulted deck elements carry away the warm air. This system also cools the thermal mass of the building interior, providing a flywheel effect that moderates swings in cooling loads.

The building has no mechanical heating system. In winter, temperatures at night and early morning can dip down to 2° Celsius, but the days are warm. The early-morning chill is kept in check by electric lighting, body heat, office machines, and the first rays of morning sun. Occupants are advised to dress in comfortable woolens.
Collaboration with engineers and manufacturers to design mechanical equipment steps beyond the normal bounds of architectural practice. Most developed societies are not open to such pioneering. But in less-developed countries and transition economies like India, the possibility still exists and should be exploited. Here, advances can be achieved practically and efficiently through experimentation, incremental steps and investments over a period of time, empirical studies, and gradual evolution, rather than formal research and scientific testing. This is often the only viable option because of limited resources. Significant advances can be efficiently achieved by way of several iterations of quick and approximate solutions that push in the right direction.

Another example of such incremental innovation in the building is the precast-concrete vaulted deck elements. These are designed to fit the structural grid of the building, which is sized for office flexibility. The shells are 25mm thick, have a pitch of 1.2 meters, and can span up to 5.5 meters. Engineers worked out the design, prototypes were tested to failure, and the design was refined by adding 5mm to the thickness to resist buckling. The next prototypes were made, loaded to 2.5 times the design capacity, released, and measured. Once proven safe and adequate, the design was put to use. The elements are not commercially tested products, but the result of experimental design.

The architects designed special reflectors to direct daylight into the building through clerestory windows. Countless designs are conceivable, with many options of materials, form, size, movement, control, etc. The design chosen consists of a gently curved sheet of powder-coated steel mounted on a steel frame. The final angle was determined by
adjusting the reflectors and observing the result, and by finding a setting that discouraged birds from perching and nesting on the reflectors. The design team developed several innovative solutions and verified their adequacy for this project. To spread such solutions on a broad scale would require mass production. Development of commercial products requires formal research, prototypes, rigorous laboratory tests, field trials, certification by independent testing institutes, and various approvals by authorities. Lall believes architects can jumpstart the commercialization of mass-produced building components by taking the first step of research and development.

Many people think that modern buildings must display an industrial image, and that traditional materials and methods are inappropriate for intensively developed cities, especially those with tall buildings. This building argues the opposite. It uses well-established materials and methods, and proves that the resulting architecture can durably meet modern urban requirements while consuming a third less gray energy.

Lall advocates a reassessment of the materials and methods developed long ago for simple and small buildings in low-density settings. Some of these can be developed for modern mass production using simple, low-energy processes. TARA Nirman Kendra does just that. It provides design-and-build services for low-cost shelter and has developed simple, small-scale production systems for earth and fly-ash masonry blocks, precast concrete elements, and micro-concrete roof tiles. Micro-concrete is a very fine concrete for casting precast elements such as roofing tiles that are a lightweight, strong, and economical substitute for fired clay tile.
Studies show that building occupants are more comfortable and satisfied when they have some control over their environment, especially regarding temperature, lighting, and visibility. The DA staff operate their own lights, windows, venetian blinds, and under-desk fans. They may open windows for ventilation when the weather is mild or cool.

This requires that staff understand how windows and shades function as part of the building’s environmental control systems. Staff agreed to learn and respect the principles; the result remains to be seen. All workspaces are illuminated by daylight, which is modulated for glare-free distribution. The conference room has roof lights that can be closed with shutters when the room must be darkened. General illumination at night is 150 to 200 lux. Desk lamps provide task lighting.
Clean water is a limited resource in many parts of the world, and especially in India. One must conserve water by using it sparingly and by treating and reusing wastewater. In the DA building all water-saving measures had to be low cost. Drinking water is primarily supplied by the municipal system, but supply is unreliable, so an on-site well serves as a backup.

All water is purified in a low-cost bio-sand, multi-layer gravity filter designed by DA for rural applications. It costs a fraction of the price of energy-intensive reverse-osmosis systems. Low-flow faucets close automatically after ten seconds. These spring-actuated faucets cost less than a sixth of the electronic versions. Urinals have automatic electronic flushing. Toilets have manual flushing; dual control offers the option of low-volume flushing, which people must learn to use.

All wastewater is treated on site in an aerobic-anaerobic digestion tank which is periodically charged with special bacteria. This water is filtered and reused for flushing toilets and for watering plants by means of a drip irrigation system that delivers water in small quantities at the roots.

Mechanical air conditioning is a large consumer of water. Refrigerant-type air-conditioning systems are most efficient when the condensing cycle uses water for cooling, but this consumes a great volume of water. The hybrid system at the DA building is expected to cut water consumption of the air-conditioning system by about 45 percent compared to conventional water-cooled systems, while maintaining high energy efficiency.

As a symbol of nature, water is also used in small pools, one of which features a large, trickling fountain. These water features serve a purpose; they are designed to cool, to enhance the environment visually and aurally.
In this project, aspirations were high but funds were low. To improve the financial picture, TARA Nirman Kendra, the construction and engineering arm of DA, fabricated much of the building materials and equipment, keeping some of DA’s funds within its organization. Many small contractors, local tradesmen, and poor itinerant workers were hired to work on the construction site. The idea here was to distribute wealth equitably through the project. The itinerant workers lived on the site during construction, and were provided adequate shelter.

The economics of the project were critical from the start because the project had to be begun before complete funding was secured. The architects held design costs down by using simple methods of experimentation and testing instead of elaborate studies. They held construction costs down in many ways, chiefly by specifying economical materials and using simple construction methods – but they refused to design a cut-rate building. The building features many aesthetic embellishments and examples of skilled workmanship. These add cost and could have been cut, but they are much
of what makes the building a work of architecture, one that expresses DA’s care for people and the environment, including the built environment. The client and the architects shared the vision not just to construct the building, but to advance sustainable construction through the project. Funds ran short at the end of construction, delaying completion, but once the hurdle was overcome, the long-term value remains.

This building is a secure investment. But the long-term value of the structure itself is small in comparison with the value for society that DA seeks to create through its activities and through this building. DA world headquarters offers sound answers to many common construction problems, ideas waiting to be commercially exploited, practical low-cost technical solutions, energy-saving methods, low-carbon strategies, and several significant developments ready to serve as a springboard for the construction industry. As a nonprofit organization, DA is happy to share this intellectual wealth for the welfare of society. Broadly viewed in this way, the return on investment for this project is immeasurable.
Technology is at the forefront of the project, but always in service of the environment and society. The project displays a fundamental concern for people in many ways. The building was shaped in close consultation with the future users. Underprivileged workers and small companies were employed. The building is fully accessible to elderly and handicapped people. A child-care facility was provided to support working families. The building provides a humane and stimulating environment for the occupants. The architecture respects local cultural heritage. As an important model of a way to build, offered to India and to global society, the building represents a significant step by DA toward reaching its social and environmental goals.

Instead of seeking to realize his own personal expression through the project, Ashok Lall served the client by collaborating, advising, and giving shape to DA’s wishes and dreams. The result is a building that is truly DA’s home. Lall’s work is a reminder of the architect’s true role in society, which can be easily forgotten by architects under daily pressure. It is the role of visionary builder – one who possesses not only technical knowledge, but inquisitiveness, inventiveness, and foresight of what type of future is being shaped.

Development Alternatives world headquarters resulted as a model of sustainable architecture only because the owner, architects, and building users shared common values and contributed their full support to the project. Likewise, only because DA and Ashok B. Lall Architects collaborated in a shared spirit of experimentation and innovation is the building such an abundant source of development alternatives.
Ashok B. Lall, BA (Hons.)
Cambridge University, UK;
AA Diploma, is Visiting Professor at the Guru Gobind Singh Indraprastha University, and Principal of Ashok B. Lall Architects in New Delhi.
“I believe that our creative imagination, by definition, is unbounded, and that the principles of sustainable design are not a limitation; rather, they provide fertile ground for engaging the imagination to nurture a vibrant architecture of the future.”

Ashok B. Lall in an interview on tradition and sustainability
Mr. Lall, in your architecture, you seek simple solutions for contemporary needs. Do you also seek state-of-the-art solutions?

**Ashok Lall:** I define “state of the art” as reaching that elegant solution to meet real needs which uses available scientific knowledge with simple means so that the solutions are accessible to a wide range of people – accessible to everyone. Perhaps like Satprem Maini’s compressed-earth-block vaults which he has developed in Auroville. I think “state of the art” is not that huge integration of elaborate means even though the results are amazing and they extend the realm of possibilities but the result is accessible only to the rich and the powerful, like going to the moon or building the tallest building. This, I think is an important way of looking at technological advance.

Your architecture draws on tradition. What do you try to bring forward from traditional architecture into contemporary architecture?

Especially in this part of the world, you can learn a great deal from traditional architecture, in the context of sustainability. Not only do you learn a lot about the materiality, and the use of materials which are natural materials, locally sourced materials, but you also learn about the spatial strategies and the strategies for response to the climate.

For example, in the northern parts of India, where the climate is hot and dry, the traditional building form usually was around a tight courtyard – not a very large courtyard, you wouldn’t call it a court, it was a smallish space, more vertical than wide, surrounded by a building, and the building would have relatively small openings towards the outside, but it would have large, arched, and very generous openings towards the courtyard. So the courtyard was like an outdoor living room. It was creating a sheltered adjacency to an indoor space. And in that sense, when the nights are cool and the mornings are cool you can be out in the courtyard; when the day gets hot and the sun is strong, you can recede from the courtyard into the room. And so there’s a way of using the indoors and the outdoors as a continuous system of habitation.
The other very interesting factor of this was that if the out-of-doors is generally in the hot season hostile, the indoors, the courtyard side, is welcoming – it’s like the oasis. And so you gathered around the oasis, opened yourself towards the oasis, whereas you protected yourself from the outside. So the alternation of aspect, into the distance, through small windows and screens and shades, towards the outside, and into the courtyard through more generous openings, and with the walking into it, towards the inside, gave a kind of an experiential spatial, an environmental richness to the rhythm of how you lived in and experienced the building.

None of these principles are anti-modernity. There is nothing about them which would go against modern needs; in fact, they would actively support any kind of modern requirement. So we found it quite natural to adopt and adapt such principles in our architecture, and of course the DA building does it quite effectively, I think. So on the whole, I would say that there are many important lessons to be drawn from traditional architecture. And you can adapt and improve on them, build upon them, to provide for today’s needs.

There is of course the other very important aspect of it, that by this type of action of design, you establish continuities from the past and you are able then in the new expression to plumb the depths of your aesthetic inheritance, of your aesthetic conditioning, which has been carried through several centuries of evolution. It gives the new architecture a regional identity, an identity of location, a sense of its own being and of its own flowering, as it were, which is very wonderful.

An extension of this idea is the debate about universal design versus regional design.

In that debate, the modernist tenet was that if you followed a certain kind of rationality you would produce a certain type of building with a universal characteristic, and so whether it is functional, or whether it is technologic, the use of a particular material, etc., would produce its own elegant and scientific form and its own vocabulary and this would then be universal – and this is exactly what has happened in
the evolution of architecture through the last century and into this century across the world.

But we are, as you can see now, seeing some change where local attitudes are being reasserted, willingly and strongly reasserted, not only as being more relevant but as a way of describing oneself, as having something of a flavor which is different from other places, and so that the distinction of one place as compared to the other enriches the world, and it is with that belief that regional architecture, expressing its locale, through its materiality, through its spatial systems, through its drawing on the aesthetic sensibilities of local tradition, etcetera, has the intention of enriching the experience of the world. I believe that every society learns from its exposure to the world; every society learns from whatever is going on elsewhere, but it appropriates it so that it can develop its own expression from within. It is this manner of cultural evolution that gives a sense of pride and confidence in oneself. And that’s a very important process.

Are people adopting sustainable practices? Is it becoming popular, or are people indifferent? What is happening in India?

Ironically, it’s the more recent ways of building, ways that have been seen over the last thirty, forty, or fifty years, which have moved steadily away from sustainable habitat design. Until that time, and in many parts of the country even today, most construction is eminently sustainable because it is simple, it is frugal, it is less energy intensive, and the expectations that people have of their buildings are not such that they become more and more energy intensive. By and large, that remains true today. But the trend, because of the twin forces of urbanization and globalization, buoyed by economic advance, are moving our cultures towards high levels of consumption and, I believe, superficial and artificial demand of the built environment, going against the principles of sustainability.

How can this be addressed?

I think the key to this lies in awareness and knowledge and in demonstration. I often give the example of how dietary habits have changed and are
changing the world over, as people begin to understand the relationship between health and diet. It is not as though people have stopped enjoying food. They continue to enjoy food, but they enjoy different kinds of food. Similarly, when it comes to buildings, if we are able to establish the relationship between our survival, climate change, environment degradation, and the way we build and use buildings, if we can establish that relationship, if we understand that linkage clearly and forcefully, then we will begin to appreciate a new way of building and a new way of living in buildings.

So when we manage to spread this awareness and knowledge, and along with that provide the examples of architecture which is elevating, which is beautiful, which is functional, which satisfies our essential human cravings for delight and comfort and convenience, when we have those examples out there, that is when the trend could reverse. What I fear though is that the scale at which, or the force with which and the speed at which, things are changing in our environment in India particularly, there really isn’t very much time left to turn the tide, although I do believe that there are some signs of the tide beginning to turn.

**Does the agenda of sustainability limit architecture?**

This is a frequently asked question. And at its root is an image of the architect as the grand artist whose art exists on some superior plane high above the mundane concerns of sustainability. But there is the other architect too – connected to and concerned about the realities on the ground that determine our collective well-being, whose art is guided by an attitude of responsible service. I believe that our creative imagination, by definition, is unbounded, and that the principles of sustainable design are not a limitation; rather, they provide fertile ground for engaging the imagination to nurture a vibrant architecture of the future.
## Technical data

### Site
- **Location**: New Delhi, Qutab Institutional Area
- **Climate**: Tropical, composite
- **Terrain**: 1° slope toward NE
- **Site size**: 3,316 m²
- **Setting**: Urban, bordering on forest
- **Seismic zone**: Zone 4, national code
- **Parking spaces**: 18 cars and 30 motorcycles in basement garage
  - 9 cars and 12 motorcycles on grade

### Building
- **Construction period**: November 2005 to November 2008 (est.)
- **Building type**: Institutional headquarters
- **Building volume**: Basement: 5,479 m³; superstructure: 10,160 m³
- **Maximum number of occupants**:
  - workplaces: 245; visitors: 210
- **Gross floor area**: 4,775 m²
- **Number of finished floors**: 5 above grade, plus basement
- **Number of basements**: 1
- **Construction**: Reinforced concrete frame, masonry walls (cement-stabilized compressed-earth block and cement-stabilized fly-ash lime-gypsum block), vaulted precast concrete deck elements, masonry domes
- **Mechanical systems**: Hybrid cooling, evaporative and refrigerant modes
- **Construction cost**: USD 2.5 million (at 1 USD = 47.6 rupees), USD 527/m²
Design team

**Architecture**
Ashok B. Lall Architects, New Delhi; Rakesh Dayal, senior associate and project manager; Anjali Jyoti, office supervisor

**Engineering**
Main structure: Subir Roy Choudhury, New Delhi
Domes and precast shells: Peu Banerjee Das & P.K. Das, New Delhi
Hybrid cooling system; research and schematic design: Dhaliwal Associates, New Delhi
Final systems and installation design: Abid Hussain Consultants, New Delhi
Electrical engineering: Kanwar Krishen & Associates Pvt Ltd, New Delhi
Plumbing engineering: Krim Engineering Services Pvt Ltd, New Delhi
Building automation systems: Shankar Rao, Gurgaon, Haryana

**Contractors**
Civil engineering contractor: Gurbakhsh Singh B.A. Builders Pvt. Ltd, New Delhi
Electrical contractor: Shivam Engineers, New Delhi
Plumbing contractor: Yash Plumbing Engineers, New Delhi
Hybrid units and controls: Vikram Hitech Pvt Ltd, New Delhi
Ductwork and VRF units: Adhunik Vatanukool Pvt Ltd, New Delhi
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Daniel Wentz
Books in this series

Office building in Costa Rica  2006

Research center in Switzerland  2007

Community center in South Africa  2008

Office building in India  2008
The Holcim Foundation for Sustainable Construction promotes innovative approaches to sustainable construction. The objective of the Holcim Foundation is to encourage sustainable responses to the technological, environmental, socioeconomic and cultural issues affecting building and construction, regionally as well as globally – through a range of initiatives, including Holcim Awards, Holcim Forum, and Holcim Projects.

An international competition for future-oriented and tangible sustainable construction projects.

The Holcim Awards recognize any contribution to sustainable construction – irrespective of scale – in architecture, landscape and urban design, civil and mechanical engineering and related disciplines.

Prize money of USD 2 million per three-year competition cycle encourages and inspires achievements that go beyond convention, explore new ways and means, and draw attention to and identify excellence.

The Awards competition is conducted in partnership with some of the world’s leading technical universities* who lead the independent competition juries to evaluate entries according to the target issues for sustainable construction.

* The partner universities of the Holcim Foundation are the Swiss Federal Institute of Technology (ETH Zurich), Switzerland; Massachusetts Institute of Technology (MIT), Cambridge, USA; Tongji University, Shanghai, China; Universidad Iberoamericano (UIA), Mexico City, Mexico; and University of the Witwatersrand, Johannesburg, South Africa. The Universidade de São Paulo (USP), Brazil, is an associated university of the Holcim Foundation.

www.holcimawards.org
A series of symposiums for academia and practitioners to encourage discourse on the future of the built environment. The Holcim Forum supports sustainable construction in the scientific field, among experts in the construction sector, business and society.

In addition to renowned specialists from around the world, promising international students from leading technical universities are invited, to represent the next generation and to share their visions.

The first Holcim Forum was held at the Swiss Federal Institute of Technology (ETH Zurich), Switzerland, in 2004 under the theme “Basic Needs.” The second Holcim Forum was held in 2007 at Tongji University in Shanghai, China, under the theme “Urban_Trans_Formation.”

Seed funding for building initiatives and grants for research projects to accelerate progress and promote sustainable construction.

Within the framework of Holcim Projects the Holcim Foundation provides USD 1 million per three-year cycle to support research in sustainable construction and the implementation of building projects. Projects nominated for seed funding are evaluated according to the target issues for sustainable construction, and must be endorsed by a local Holcim Group company.

The Holcim Foundation acts as an enabler for both research projects and building initiatives so that, whatever their origin, exciting and important new ideas can be more widely implemented and tested by a broader audience of specialists.

www.holcimforum.org

www.holcimgrants.org
The ecologically-friendly and culturally nuanced building of Development Alternative in New Delhi includes molded terracotta tiles that form a jali (patterned screen) feature common to traditional buildings in northern India. The tiles are filled with insulating vermiculite plaster and some host recycled mirror fragments that glint sunlight and enhance the dimensional effect.

**Alternatives in urban architecture**

**Sustainable construction**
- Quantum change and transferability
- Ecological quality and energy conservation
- Ethical standards and social equity
- Economic performance and compatibility
- Contextual and aesthetic impact

**Development Alternatives world headquarters**
- Preserve, expand, or replace?
- Consultative and collaborative design process
- New building in the same spirit
- Space, form, and material
- Low gray energy
- Passive cooling
- Innovative air conditioning
- Research and development
- Illumination and ventilation
- Water conservation
- Economic value
- Social service

**Tradition and sustainability**
- Interview with architect Ashok B. Lall

**Technical data**

**Design team**

**Credits and acknowledgements**

**Books in this series**

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Office building in India