THE PATH OF GREEN

REVISED EDITION

Prem Jain

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A Tribute

DEDICATED to
MA, my Guru

INSPIRED by
My beautiful little world of
JAI and YASH, my lovely twins

MANISH, my son from love, not by birth
PAYAL, my child more precious than life
and
RENU, my soul mate
through many a birth

Contents

Foreword

He passed away as cheerfully as he had lived.

He often spoke of how his Ma used to tell him stories of Jain munis who embraced death as cheerfully as they did Life. When he told his dear daughter six days prior to his breathing his last, that he wanted to liberate his soul like many saints had done over timeless millennia, he was at one with his Maker, and showed how fully and wholly he was suffused by that deeper, larger consciousness that India as a civilization has been.

There were mails he wrote even a dozen days before his demise. He died virtually in harness like the true Karma Yogi that he was.

Every feature in *The Path of Green*—a title he chose—is leavened with memories of fondness and admiration, and of deep gratitude.

It is not many who have the privilege of a brush with greatness. He offered that to the few who are contributors to this book and to the many thousands who were his students, his friends, his clients, his compatriots of many hues.

He often said India was the Jagat Guru of Sustainability. He tirelessly urged every Indian to do what he could for the *Janani Janmabhoomi*.

When Payal Jain, his only daughter, put together a book some years ago, she captured elegantly how an imbued sense of idealism wove a powerful strand in his early life. He was deeply attached to his mother and spoke a great deal of those early years of 1950s when she insisted that her son go 'for higher studies' to the US and sold her jewellery—a memory that always evoked tears of gratitude from him. His exuberant and cheerful exterior concealed a sensitive mind—he was a great fan and admirer of his wife's sitar playing, and not many know that he occasionally entertained at home with the flute which he played mellifluously.

In a country where we know how to burn our dead with reverence and bury them by neglect, but not how to honor or appreciate them while living, how we wish that this book was not posthumously published, but done when he was still around! It's most befitting that the IGBC has taken this opportunity to present this book, which was his brain child, his idea. Many of you readers would agree that there is far more to be done. The Prem Jain Memorial Foundation that his daughter has now founded is going to bear the torch and nurture his mission of inspiring many more young Indians.

If India is second only to the US on the Green Building footprint, a whole lot is owed to this one man's never-take-no thrust, with a slew of large and very large projects saying Yes to his charming ways. The surge in Green Buildings from just the turn of this decade was unique and phenomenal and unparalleled in the world—and there is no argument at all on who turned the tide for the IGBC. There comes a time in the destiny of a nation when it is the envy of the world. Dr Jain knew that moment when it came and he helped many proud Indian business leaders seize that time, and take the tide.

As one of the contributors to these pages has said, Prem Jain lived richly up to his name. From a paraplegic Sean in Australia who the young Prem met as a young engineering student on an educational tour (Sean passed away some months after the young Prem returned to India, and Sean's mother wrote to him to tell him how, on her son's deathbed, he had told her he was happiest for the last four months because of the love and care Prem had bestowed on him), to many of us who left every meeting with him feeling taller and brighter, he towered in his humility, and brought an infinite sense of love and affection to everyone who knew him.

Dear Dr Jain, we know you're here right by our side, even as we read these lines. We sure hope you approve of this book. You wrote it no more than 20 days before setting your body at rest, saying: "My book is on my learnings during my journey of 40 years and more, on The Path of Green, and for my unconditional and absolute love for our *Janani Janmabhoomi* Bharat. It will be my humble contribution to our younger generation of Jai and Yash (his darling grandchildren soon moving out of their teens) and generations not yet born." I hope it meets your eagle eye for detail. I hope we meet your exacting norms in serving this great nation in what is left of our lives as this ancient civilization marches on towards her own true destiny.

There is no Obituary page in the best of our newspapers. In other cultures, the passing of a great or unusual individual is the occasion for a reflective assessment of his life and work. In India, the death will be noticed only as a 'news report', and left at that. For the most part, these news items are exercises in deference; recitations of achievement with little reference to context. Indians tend to be excessively respectful towards their subjects. Or so morose at a death that a celebration with writings is usually not conceivable.

Take this other side of this remarkable man. He always grew misty-eyed when it came to his *Janani Janmabhoomi.* A man has one birthplace, one motherland, and one country. Those years outside the country in the Sixties deepened his conviction of how a man can only have one country—and the place of his birth is the most important factor in his life. He felt an intuitive bond with the multiple varieties of peoples and cultures that India represents.

Prem Jain was no intellectual. He was rooted in those early memories of a Delhi Jain home with all the joy, reverence, devotion, faith, and the inexplicable bond of family and kin.

In the last week of his passing, he chose to make a remarkable decision. Like those eternal Jain Munis he chose to join the larger consciousness. "He is now determined to liberate his soul from the body," Payal wrote four days before his passing away.

Being a 'Nehruvian Indian' is to deny that there is any single essence to Indian civilization, to reject the idea that one can list some core attributes of what it takes to be an Indian. Prem Jain was one such Indian. He was among the last links to India's timeless continuum of deep unwritten traditions and conventions.

—Hariharan Chandra
Chairperson, Biodiversity Conservation, India.

Through whatever path
Thou leadest me
I shall at last arrive
At the temple door

—Rabindranath Tagore

Preface: The Wonder That Is Bharat

This childhood melody rings in my ears, "My Country, Right or Wrong!"

My love and devotion for my Janani Janmabhoomi is absolute and total, like the devotion of the legendary Bhishma Pitamah.

I carry the Junoon of working for my BHARAT, so that she may once again attain her ancient glory and lead the world, in preserving all life forms on our beautiful Mother Earth.

—Prem Jain

Introduction

PANCHA BHOOTAS

We carry in our blood the heritage of 5000 years of worshipping Nature in all her ethereal forms. 'Green' has been the way of life for one and all in Bharat for centuries. It is our firm belief that all life in Nature is composed of five essential elements, called *Pancha Bhootas*. These are:

Bhoomi (Earth)

Gagan (Sky/Space)

Vaayu (Wind)

Agni (Fire/Energy)

Neer (Water)

In order to cajole a common person to revere Nature, our scriptures identify each of the Pancha Bhootas as a divine form.

Let us consider them:

1. Bhoomi: Dharti Ma (Mother Earth)

Seeds in her bosom bloom, giving food to nourish all life, and bearing all forms of life in herself. Mother Earth and motherland—Bharat—become one and the same in the ancient saying : *Janani Janmabhoomi.*

The ancient tradition of Bhoomi Puja, or worship of the land, has survived centuries. A copper vessel (since it is considered imperishable) containing tiny replicas of a snake couple made of metal is buried below the future foundation of each building. It is to seek forgiveness for displacing life forms from their natural abode, and to bless the new construction which must come up in its place. There can be no finer example of reverence to all life forms on our Mother Earth.

So sacred was Mother Earth or Bharat Mata considered, that traditionally, morning ablutions were performed along flowing streams, and near plants that, according to Ayurveda, cleaned up all organic waste matter in the water that passed through their root systems. In ancient times the Sarovars were reserved for drinking water and for Prakshaal (holy bath of idols) in adjoining temples. These were kept unpolluted by the cascading waterfalls or fed by natural springs.

Traditionally, solid waste consisted mainly of burnt clay vessels; containers made of leaves or wood; bamboo or wood articles of furniture; and natural fiber clothing. Old clothes were bartered with utensils, mended and recycled till unusable, and then used as mops. Thus our tradition was of total recycling, leaving behind no waste. Even the dead were cremated so that the Pancha Bhootas became one with Nature. Effectively, there was little or no accumulation of waste on Mother Earth.

2. Gagan– Space/Heavens(Indra)

Lord Indra is the Keeper of Indralok, abode of Gods, and He rules the firmament, including the Nakshatras or the nine planets with Rahu and Ketu.

Astrological science evolved on the basis of their holy or not-so-holy influence on earthlings, and accordingly predictions made for Shubh, or auspicious times, and Ashubh, or inauspicious ones. Heavenly blessings are synonymous with auspicious times, and major activities undertaken during these times are believed to be trouble-free and successful.

3. Vaayu– Air/Wind (Vaayu Dev)

Life on our beautiful Dharti Mata exists because of the mercies of Vaayu Dev, who gives us breath—the basic element for life. The winds and the breeze were considered to be manifestations of Vaayu Dev's pleasure, while hurricanes, tornadoes, cyclones, etc. were considered the God's show of temper. Pranayaam, or Yogic breathing, is an ancient Indian system based on the control of our breath so that we can lead a healthier life.

Bharat has the potential for large wind power generation from steady coastal winds. Wind power is being harnessed with modern technology, and Wind energy is set to become an important source of alternative energy with time.

4. Agni—Fire/Energy (Surya Dev)

Worship of the sun is a tradition as old as the human race. Agni has been given the highest importance amongst the Pancha Bhootas. The sun has been considered to be the Shakti-Punj or the storehouse of all energy. Fire or heat

is imperative for daily existence, therefore Agni has been revered for purity and power.

The landmass of Bharat has five climatic zones that range from hot and dry, to cold and moist. But it is incredible that every corner of Bharat gets, on an average, more than three hundred days of sunshine throughout the year, thereby lighting our hearts, our minds, our workplaces and our homes. This bounty helped in the perfecting of the science of Yoga – morning exercise rituals performed outdoors, including the Surya Namaskar or sun salutation—for enhancing our well-being.

In recent times this abundance is being harnessed to produce solar energy – an environment-friendly source of power that can solve many of Bharat's problems.

It has been proven that with modern developments in the growing construction industry and the availability of renewable solar energy, all our current and future needs of energy can be produced through solar farms across the Thar Desert alone. Once the techniques for collection/harvesting, transmission and distribution of this abundant green power is developed, Bharat will become self-sufficient with green power.

The cost of solar power generation is already well below thermal and nuclear power generation, making it a win-win solution.

5. Neer –Water (Varun Dev)

Water is the elixir of life. Bharat is abundantly blessed with water, thanks to the mighty Himalayas that give birth to perennial rivers. These rivers cascade down hills and valleys, enriching our soil. In *The Discovery of India,* Nehru postulates how all civilizations have grown and developed near riverbanks. The perennial and rain-fed rivers have been

sources of drinking water, and traditionally used as waterways for travel and carrying freight to various parts of the country. Therefore, ancient Bharat worshipped its rivers. Many were named after the divine Shakti and feature as significant characters in our mythologies such as Ganga, Yamuna, Saraswati, Narmada, Kaveri, etc.

Another blessing for Bharat is the monsoon. It has given birth to classic literature like *Meghadutam* by Kalidasa and *Barsha-mangal* by Rabindranath Tagore.

Year after year the monsoon arrives, revitalizing our rivers, our Sarovers (lakes), our Baolees (wells) and our canals. It is estimated that if every drop of rain that falls on Bharat is harvested, we would be a water-surplus nation today and for all tomorrows to come.

In Bharat, the tradition of rainwater harvesting is as old as civilization. A classic example is Mohenjo-daro with its ingenious conveyance and storage of rainwater. Numerous Baolees built over eras stand testimony to our ancestors' knowledge and practice of rainwater harvesting.

The mighty rivers of Bharat also endow it with a huge potential for hydro-power generation. Hydel-power plants have been set up to lessen fossil-fuel use.

Ancient wisdom regarding the worship of Nature through these Pancha Bhootas has survived the ravages of time, the repeated onslaught of modern technological advances, and the false value system of 'comfort at any cost'. The need of the hour is to combine ancient wisdom with state-of-the-art technical developments to create a sustainable built environment. This would meet the needs of a developing Bharat to conserve and recycle, and to bring back ancient practices of skillfully optimizing our limited natural resources of stone, iron, timber, bamboo, straw, rock, energy and water among other things.

Chapter One

Traditional Indian Architecture

Traditional Indian architecture has evolved around the optimization of the Pancha Bhootas, in harmony, and with reverence to Nature. The well-preserved excavation sites of Mohenjo-daro speak of a phenomenally advanced science of township planning, of living and recreational quarters, of water conveyance through intricate canal systems, and of rainwater harvesting—all dating back to more than four thousand five hundred years.

Lord Rama performed the Ashwamedha Yajna in Kashi, modern-day Benaras. It is considered to be the oldest living city on Mother Earth, which has survived the ravages of time, countless earthquakes, floods, plague, famine and other natural calamities. The Kashi Vishwanath Temple has existed for centuries; even today devotees throng to pay obeisance to the ancient Jyotirlinga - the holy symbol of Lord Shiva.

Sixth to fourth century BC is considered the golden age of Bharat, when Buddha and Mahavira lived and preached. Sir Edwin Arnold in his masterpiece *The Light of Asia* describes in vivid detail the Vishramgriha, or living quarters in the pavilions that were built on terraced hills, the carved beams

and pillars of the courts, paneled doors made of sandalwood, and marble latticed roofs. These merged and rose in reverence to Nature, and were the ultimate guide and guru for the builders and architects of yester years.

It is believed that somewhere around ninth to eighth century BC, Maharishi Veda Vyasa composed Bharat's greatest epic, the Mahabharata. According to mythology, Vishwakarma, the deity of workers, created Indraprastha, the capital of the Pandavas, on wasteland. Vaastu Shastra, the science which directed architecture, town planning and ergonomics, also came into being at that time. It defines the basic principles of orientation, shapes of buildings, placement of important elements, the use of daylight and prevailing wind direction to optimize the five elements of Nature. It identifies the location of Brahmasthaan or the living quarters, the workplace, rainwater harvesting system, the storage of usable and wastewater, as well as the preferred location of energy consuming devices. Vastu Shastra, a system that is being revived once again, was the basis of ancient architecture.

Temple Architecture

The finest examples of traditional Indian architecture built on the principles of Vaastu Shastra are our temples across the length and breadth of Bharat. The sanctum-sanctorum invariably has a Shikhar or peak. It soars to dizzying heights and has a well-ventilated, sheltered pavilion for devotees to meditate in. Most temples have designated space for Parikrama (forming a circle in clockwise direction) around this sanctum, often populated with small individual temples along its outer periphery.

Hundreds of temples are centuries old, where Puja (ritual of meditation) is still performed regularly. For instance, the

Mewar dynasty of Udaipur, Rajasthan, is one of the oldest dynasties in India. The rulers were the Maharanas, guardians of Ek Ling Ji, the embodiment of Shiva. The royal family members visit the Ek Ling Ji Temple every Monday to offer Puja and give alms, a tradition that has been kept alive through centuries and continues.

What is the magic of such long lives of these edifices? These are all built to optimize the Pancha Bhootas, as illustrated by the science of Vaastu. The site is chosen with due respect to existing waterways, without disturbing the ecological system, the flora or fauna of the place. All materials used in the construction come from the earth, such as regional stone, timber, copper, clay, lime, bamboo, straw, rice-husk, and other farm produce. All these are totally recyclable, leading the lifecycle from cradle to cradle, hence resulting in Zero accumulation of solid waste. The tradition of the Aangan (central open courtyard) brings daylight and fresh air flow into every nook and corner of the building. The openings or Jharokhas are planned in accordance with the prevailing wind direction. And finally, rainwater storage from the Sarovars is directed for recharging ground water, optimizing the conservation of water.

Mughal Architectue: A seamless merger

For centuries, Bharat has been known as the Golden Bird, attracting foreign invaders from the north and northwest, who plundered and looted heartlessly. They were repelled by the Rajputs and Marathas. No one was allowed to penetrate the southern parts of Bharat, where religion, temples, mode of worship, music and art has thankfully remained intact. Our ancient manuscripts are still preserved in the southern parts of Bharat.

The most remarkable influence upon Indian architecture was by the famous benevolent Mughal Emperor, Shah Jahan. He was a great visionary and he ensured that Mughal architecture seamlessly merged with traditional Indian architecture. He built edifices, forts, mausoleums, mosques and palaces of wondrous beauty. The Red Fort in Delhi, the Red fort and Fatehpur Sikri in Agra are well known, but the most outstanding of these and amongst the Seven Wonders of the World is the Taj Mahal.

All these beautiful edifices have survived over 500 years of floods, famines, earthquakes, cyclones and other natural disasters because of the optimization of the Pancha Bhootas, by merging traditional Indian architecture with the majesty of Mughal architecture. Most of these are located on riverbanks, on plateaus high above floodplains. The materials usually used for construction are stone, clay bricks, lime, timber, bamboo and sand - all completely recyclable. Jharokhas used for directing prevailing winds inwards, day lighting and zero-waste were the sacred principles of design. Mughal architecture brought us inventions like the cavity wall construction, the Jaali (latticed screen), Mehraabs (arches), Gumbads (domes) and Minars (minarets) to lend grandeur in design. Thus, the fusion of the two principles of architecture created visually delightful, highly functional edifices. The thick outer walls created a thermal mass to soak up the sun's heat during summer days and radiate it back to the night sky, thus insulating the interiors from external heat. Evaporative cooling across damp Khas (grass) screens added to the thermal comfort of the occupants. Small openings were created on the windward side, to coax prevailing winds across the screens and larger openings were created on the lee-ward side to ensure that the cooled air completes the process of thermal air-cooling, without any requirement of power.

Modern Construction Materials

The dawn of the twentieth century saw Bharat import modern construction materials—namely cement, steel, aluminum and glass—from England. The use of thermal mass thick stonewalls disappeared with the last forts built by the Mughal kings. Buildings suddenly became slender, and mechanical systems arrived with pumps, fans, air-conditioning and other electrical energy consuming devices.

Mahatma Gandhi's Civil Disobedience Movement gave Bharat Independence on August 15th 1947, through non-violence - unprecedented in human history. Independent India gave rise to a generation of master architects like B.V Doshi, P.G Patki, Karim Noorani, Narayan Rao, Charles Correa, Raje, Kanvinde, Raj Rewal, Satish Gujral and many others. The common link that binds their magnificent creations is their respect for Nature, the adoption of Vaastu principles to optimize Pancha Bhootas, and the ingenious use of modern construction materials to ensure the conservation of energy and water, thereby minimizing construction waste. Most of these great masters have also been benevolent gurus, passing on their learning and experience to the younger generations of architects.

The last two decades have been the age of our young master architects across Bharat, who religiously carried out their guru's teachings. Most well-known to me, among the young master architects are: Karan Grover, Nimish Patel, Parul Zhaveri, Rajiv Kathpalia, Vimal Patel, Munawar Noorani, Shekhar Patki, Sandeep Shikre, Kiran Kapadia, Mala Singh, Sharukh Mistry, Raghvendra Rao, Shakuntala Ghosh, Poorva Keskar, Jit Kumar Gupta, Jitendra Mehta, Ashok Mokha, Anupam Mittal, Rajinder Kumar, Jasbir Sawhney, Manit and Sonali Rastogi, Mohit Gujral, Abhimanyu Dalal, Sonali Bhagwati and many others.

Working with some of these dynamic architects, I learnt how they spend considerable time—even before their first doodling for any major project—listening to the story that the site tells: the murmur of all life sustained by that earth, the natural waterways, prevailing wind direction, the climate and diurnal variations, flora and fauna, the birds and their nests, as well as the local and regional arts and crafts, the language and cultural practices of the place. These factors mold their creative instinct for the design of their projects, honoring the client's requests, or convincing the client to modify their expectations to respect the age-old traditions, and to maximize the use of local and regional materials.

The Flip Side : Use of excessive glass

The last forty years have also witnessed the sacred space of Indian arts and architecture being invaded as never before, by a breed of commercial architects, many of them having been educated and trained abroad. They violate with impunity centuries of ancient knowledge of Vaastu and show disdain for the traditional practice of designing and construction in harmony with Nature.

The central theme of their design is comfort-at-any-cost, maximizing the usable area and minimizing the time of approvals through all means - fair or otherwise - and minimizing the time of construction with abundant use of glass and metal. The design time is reduced to a bare minimum by applying the formula 'one solution fits all.' There is no concern for local climate, daylight, wind direction or the surrounding flora and fauna. Therefore, the same design principle is applied to their work—be it in Mumbai, Delhi, Jaipur, Guwahati, Kolkata, Hyderabad, Mysore, Chennai or Cochin.

These commercial architects are the darlings of countless developers and builders, who pay them handsomely. They flaunt the architects' name for the sale or lease of homes and office spaces to vulnerable buyers. The user discovers the bitter truth only after occupying the premises—when the monthly power bill is astronomically high, water flow is scanty and there is no water for potted plants, the lack of fresh air circulation causes ill health, and access to the premises is tortuous because of faulty infrastructure planning.

One of the main causes of these ills is all-glass construction that is intrinsically hostile to Bharat's climate, where we have three hundred or more days of bright sunshine. The occupied spaces on the western and southern sides become heat sinks. The glistening facade of the building becomes a curse for the users inside.

The Indian Parliament had passed the Energy Conservation Bill a long time ago. National Building Code (NBC) 2005 gives clear guidelines for construction in Bharat's five climate zones. But these are recommendations, not mandatory guidelines. Therefore, these commercial architects, builders and developers get away by misleading unsuspected users. In 2007, the Bureau of Energy Efficiency (BEE) formulated the Energy Conservation Building Code (ECBC). This has been subsequently passed by the Central Government and a Gazette Notification has been issued. However, Indian Democracy gives liberty to the thirty odd States and Union Territories to mandate ECBC, NBC and other codes and standards only after the State Government incorporates these in their local bylaws. Hence these pearls of wisdom languish in our books of codes and standards, year after year, while insensitive architects, builders and developers sing their way to success by fooling vulnerable users.

But all is not lost. There is a ray of hope, shown by the Indian Green Building Council (IGBC).

Chapter Two

CII–IGBC Is Born

The new Silicon Valley of India, Hyderabad, spread its wings surely and steadily, fully complementing all IT prerequisites. Hyderabad also excelled in the availability of assured power supply, a modern communication network, good roads and a dependable public transport system; above all, there were highly qualified, English-speaking local youth ready to be employed.

The greatest USP of Hyderabad in the year 2000, was the visionary computer-savvy Chief Minister of the then united Andhra Pradesh. He governed the state using the best IT tools of the times like a mastermind, a CEO of a corporate house. He was willing to learn and explore new avenues to improve the quality of life of the people, and to constantly enhance their quality of education, standard of living, and provide the finest medical care facilities.

Soon, President Bill Clinton of USA came to India for a state visit. His itinerary included a state visit to Hyderabad to meet the Chiefs of several US companies with large investments in Hyderabad. He also planned to meet the charismatic CM, but first he decided to visit these MNC

offices and address their staff, including senior expats from USA. He learnt that without full verification, many MNCs had engaged architects who had studied in USA and recently returned to India. They had little or no knowledge of traditional Indian architecture, the science of Vaastu, or were insensitive to the Pancha Bhootas—the fundamental prerequisites of Indian architecture. They had scant regard for the undulating landscape, flora, fauna or topography of Hyderabad. Hyderabad with its semi-arid climate is interspersed with hills having ancient rocks precariously perched on top from times immemorial. It presents a surreal landscape. The ancient rocks, spread across the whole hillock ridge, were flattened to create a flat base (rather than terraces). With impunity these rocks were crushed to make concrete. The result was that most MNC offices in Hyderabad could have been in Manhattan, Chicago, San Francisco, Geneva or Melbourne –they had nothing specific to India or Hyderabad. President Clinton was aghast at the butchering of the city by the multitude of American corporates.

In the official meeting with President Clinton, Mr. Naidu understood the critical and urgent need for a Green Business Centre, where corporates from all over the world that come to Hyderabad (or other parts of India) for setting up operations, could get first-hand knowledge of Indian architecture, our climate zones, our solar movement, diurnal variations, prevailing winds, traditional construction practices, arts and crafts.

The Confederation of Indian Industries (CII) is a professional body more than a hundred years old. It is the voice of industry in Bharat for the Central and State governments. The charter of CII does not allow any political participation; that is why it is admired and respected by all bureaucrats and political parties. CII has more than 7000 members and comprises industry giants as well as small-scale

industry units. For more than a hundred years, the CII record has remained unblemished.

Mr. Naidu decided on a Public Private Partnership (PPP) with CII as the private party to design, construct and operate a Green Business Centre in Hyderabad. About five acres of prime virgin land in Hi Tech City was allotted to CII with a hundred year lease against just one rupee lease money. The term Green Building was then known only to a handful of professionals like us. Dr. Padmanabhan, Head of USAID India and a distinguished member of CII, pitched in with financial support and made arrangements for CII delegates to visit USA. The objective was to meet the leaders of the US Green Building Council (USGBC) in Washington DC and have an accelerated course in design, construction and operation of Green Buildings, a method of evaluation and design, as well as submission of documents to and certification by the USGBC. The mission also included visits to the best designed Green Buildings in the US, and meetings with their architects as well as project teams. The delegation returned with comprehensive knowledge of Green Building certification parameters as defined by the USGBC.

Green Building Councils have been founded in Japan, Britain and other European countries, but their guidelines for the design of Green Buildings and certification by their Councils, have been highly theoretical, complex and beyond the understanding of even well qualified users. Therefore, their acceptance has been abysmally small. When USGBC was founded in Washington DC, the fundamental objective was to make it user-friendly, without compromising the requirements of sustainable design, construction and operation. Dr. Mark Ginsberg of DOE gave USGBC a huge grant sensing the potential of immense growth. USGBC exceeded DOE expectations by leaps and bounds in the first five years itself.

CII launched the Indian Green Building Council (IGBC) in 2001, from their Hyderabad satellite office, in the presence of the CM, the visionary behind the initiative. An MOU was signed with USGBC for ten years validity, to share their best practices and with the approval to use their recognized 'LEED' program. Various subsections were modified to meet Bharat's needs, such as awareness of the acute shortage of water, using local materials, and giving importance to the safety of construction workers. These conditions became prerequisites. IGBC then started using a modified USGBC program under 'LEED for India', for commercial and institutional Green Buildings everywhere in Bharat.

World's Greenest Business Center Comes Up In Bharat

In order to meet President Clinton's challenge, Jamshyd Godrej opened the chest of his Family Trust. No ceiling was kept on budget, the essential brief was to design and construct the 'Greenest Business Center on the Planet'. As proud Indians, the project team was committed to creating a marvel - a certified Green Building, by integrating Bharat's ancient wisdom with the then state-of-the-art technology, for Sohrabji Godrej Green Business Centre (GBC).

CII handpicked the most amazing project team. The major contributors were Dr. Padmanabhan of USAID, Dr. Kath Williams of USGBC, Mr. Jamshyd Godrej, Chairman of Sohrabji Godrej Trust and the following major players:

Mr. H. N. Daruwala and Rumi Engineer, representing the donor.

Mr. S. Raghupathy and S. Srinivas, representing CII.

India's brilliant Master Architect Karan Grover, leading the design team.

India's premier consultancy Spectral Services Consultants, represented by me and my colleague Ashish Rakheja.

India's leading architectural firm CRN, represented by Raghvendra Rao and his brother, for PM/CM.

Ankur Sanghvi for green consultancy.

Alongside were young professionals handling other responsibilities for the project.

Such a confluence of brilliant professionals, working in complete harmony for a single project had never happened before, and may not happen again. The result was a marvel of architecture and engineering, one of zero waste and zero effect on the ancient rich biodiversity of the land.

Some of the unique features, applied for the first time in a modern commercial/institutional/professional group headquarters building, are as follows:

1. The building is wrapped around an Aangan or open-to-sky courtyard. The building width is confined to a maximum of 12 m so that daylight can reach all occupied spaces. With 300+ days of sunshine in Hyderabad, no artificial light (except task lighting) is switched on throughout the day while the sun is shining - leading to huge energy savings, better IEQ, better health and well-being of its occupants.
2. The Aangan is beautifully landscaped entirely with native plants, which have faced years of rain and drought, dust and heat.
3. The building envelope is constructed of autoclaved aerated concrete (AAC) blocks with built-in thermal resistance to minimize heat ingress leading to energy savings from reduction in air-conditioning energy consumption. All exposed roofs are provided with 50mm thick extruded polystyrene slabs of insulation, laid in slope (for roof drainage) over mortar, finished with a

layer of chemical waterproofing and broken glazed tiles. This provides a high albedo surface to reflect the sun's heat and minimize heat ingress from roof terraces all day long, thereby reducing energy consumption because of the reduced air conditioning load.

4. Perimeter glass is maximized on the north and east sides, and is less on the south side and minimum on the west side. All glass used is imported argon-filled double glass (DGU), 25mm thick, with 6mm thick panels and 13mm argon filled space. DGU permits minimum heat transmission, thereby minimizing energy consumption through reduced air-conditioning load. DGU also provides excellent inhibition of external noises entering occupied areas, thereby improving IEQ, health and well-being of occupants.
5. Green consultants provided computer simulation for optimization of the envelope design. The window to wall ratio (WWR) was kept well below 30 in order to maximize daylight without glare, and to minimize air-conditioning load.
6. Green roofs were provided on some parts of the terrace after analysis, and after providing for the water ponding required in maintaining green roofs. The experiment has been highly successful and is the USP of the Godrej Business Campus. This has started a chain reaction, vastly improving the overall thermal insulation in buildings all over the hot and dry climate zones.
7. The traditional Bhoomi Puja was carried out by offering a copper vessel filled with grain and tiny metal images of two snakes inside the vessel and burying it below the foundation of the building. Through this ritual the entire project team seeks forgiveness from all existing life on that piece of land for displacing them from their

natural habitat. Such reverence for all life forms is one of the reasons for our grand success with the Green Building movement in Bharat, I think.

8. During the excavation for building construction, the topsoil of up to 300 mm depth was preserved. This was then carefully piled on an unused portion of the site, kept mulched, and later reused to provide fertile topsoil on the finished ground. This elaborate procedure added to the aesthetics and the un-spoilt ambience of the landscape adjoining the finished building.

9. Construction-related site disturbance was restricted to a minimum area by barricading the rest of the site. The idea was to maintain the existing bio-diversity in its pristine form, which added an iconic status to the green oasis, amidst the concrete and glass jungle all around.

10. The site was heavily undulated. The low-lying area at the rear of the building was selected for traditional rainwater harvesting. A shallow pond was created with geo-membrane layers at the bottom and stone pitching on the sidewalls to eliminate seepage of stored water. The landscape was finished to gently slope towards the Sarovar to harvest most of the rainwater which falls on the 5-acre site, without disturbing any of the ridges on minor hillocks. Over the years, this has grown to become a mini natural wildlife preserve. Dozens of cobras, scorpions and other small reptiles have been caught; none of them have ever harmed any occupant, and they have been rehabilitated into the wilderness outside the city limits.

11. All toilets have been placed in one wet block facing the Sarovar. WC discharge is directed to small streams, which have special plants (using the traditional knowledge of Ayurveda). They clean-up all the excreta through photo remediation, making plants thrive, and

give clear odorless water which flows out to the Sarovar. This natural process of treating sewage with zero energy consumption and using only the Pancha Bhootas, has been practiced for centuries. The sages used these very plants to clean up the water they used for their ablutions, and never left any excreta to accumulate on Mother Earth to compromise her sanctity.

12. Another outstanding feature of the landscape is the Sheetal Minar, inspired by the famous Chaar Minar. A shallow tower made of fired clay bricks has been built on the site. Pebbles are filled in it to create a thermal mass. The tower top has a weather cap with a stainless cylindrical screen (to prevent birds perching). The height of the tower is based on the existing wind speed in that region in order to induce the hot and dry breeze to flow down the Minar. An automatic sprinkler system drenches the stone with water from the Sarovar at night, creating a cool (through evaporation of water) thermal mass for the day. The terminal units for air-conditioning draw the hot and dry breeze down the tower, precooling it (without adding moisture) across the cool thermal mass. This precooling or tempering of the fresh air leads to large savings in energy for the air-conditioning system. This showcases how aesthetics, combined with an understanding of the climate and using recycled water, can result in huge energy conservation, while enhancing the IEQ, health and well-being of the occupants. This innovation won special recognition for us by the American jury while they were evaluating our project submission.

13. A highly specialized tailor-made water-cooled central air-conditioning system was designed, comprising highest-efficiency components from various parts of the world. Chillers, equipped with IPLV of the order of 10, double skin air terminals equipped with the

highest efficiency backwards-inclined blade blowers, and high-efficiency split casing induction motors were also imported. Also a handful of double-pan double-skin fan coil units for cabins, variable speed-variable flow centrifugal pumps, vane-axial and tube-axial ventilation fans, variable speed induction cooling towers with 30 F approach, and a complete building automation system was brought into the country from across the globe. The resulting overall efficiency of the assembled air-conditioning system has been less than 1.25 IKW/TR in 2003, unmatched in 2003.

14. Toilets were provided with dual flush cistern (6L/3L) with anti-symphonic cleansing, water-less urinals for men's toilet, and low flow fixtures for washbasins were all imported from various countries. Each fixture is individually vented along with the last manhole to prevent any smell. All grey and black water passes through a root zone system to the Sarovar. Toilets are naturally ventilated.

15. The kitchen was located next to the toilet wing to keep all wet areas near the Sarovar. Stainless steel hoods using grease filters and double drain pans with automatic sprinklers were imported from Europe. The grease-filled water is directed through the root zone system to the water source. Thus every drop of water consumed for washing, cooking, and bathing by the permanent staff, except for the drinking water, is recycled. This results in a huge reduction in domestic water consumption, less than half of the NBC recommendation of municipal fresh water supply for commercial establishments. Water for landscaping, cooling tower makeup, and supply to WCs is completely recycled water.

16. The crowning glory was providing 100 KVA of green power through a roof top solar unit. Our ancestors used

to be mystified by the power of sunshine. Our sages, through intense Sadhana, discovered that life is the sum total of Pancha Bhootas, with Surya, the sun, at its core. Surya was considered to be the energy source or Shakti-Punj with limitless inexhaustible energy. It is only in the last few decades of human history that we have learnt to harness the sun's energy to generate green power. Therefore, despite the phenomenal capital cost at that time, the 100KVA solar rooftop PV power generation was provided to meet all essential power needs of the Godrej Business Centre. Since GBC operates on working days, the PV generated power has been connected to the grid supply, to fully utilize its potential throughout the year.

Green Building Award For Godrej Business Centre, Hyderabad

Our submission was made to USGBC on their standard template. Many of our strategies, based on tried and tested ancient wisdom, went completely over the heads of the western jury who wanted more details. But the vast potential of our design mystified Dr. Kath Williams, the Chairperson of USGBC. She flew to Hyderabad, hand-held the project team for ten days, rewriting every credit in a language that the western jury could relate to. Kath came to us as a messiah and has since become a cherished friend and guru for all of us at IGBC. She considers Bharat to be her second home.

USGBC awarded the highest points to the Godrej Business Centre, Hyderabad, declaring it to be the greenest certified building on the planet. Our mission was accomplished! The Green Building movement in Bharat thus started with a big bang! His Excellency, the President of India, the eminent nuclear scientist, Dr. Abdul Kalam,

made an exception for this private group and inaugurated the completed building in 2003. This was our first humble step for IGBC in its glorious journey of a thousand miles. Since then, we continue using great passion, commitment and determination to once again make Bharat 'Jagat Guru in Sustainability', fulfilling the sages' prophecy that this is 'Bharat's century' to shine.

Journey Of The Path Of Green Turns Spiritual

Bharat has enormous diversity in culture, languages, customs, traditions and all else but the underlying current that unites us all are abiding spiritual values. We may call Him by different names, have different modes of worship but the theory of karma binds us all. We realized that for 'Green' to be the way of life once again, our movement must have spiritual connotations.

Secondly, just doing good would not suffice, Green Buildings have to be made commercially viable. With these fundamental mantras, it was decided to assess the Green quotient or sustainability achievements, so that the Pancha Bhootas could be optimized for the built environment. Also, the local and regional manufacture of Green materials would have to be the focus for making a difference in the capital cost over conventional buildings, and it must be recoverable within a maximum of three years through operational savings. In other words, the lifecycle cost of a Green Building would be well below that of a conventional building.

We will now look at the strategies applicable specifically for Bharat, to optimize each of the Pancha Bhootas in the built environment, to design, construct and operate Green Buildings for each of our five climatic zones.

Chapter Three

Materials

THE EARTH: BHOOMI

Earth has enough to meet everyone's need
But not their greed

—Mahatma Gandhi

The Earth As Our Mother: *Janani Janmabhoomi*

The most important elements for built environment are the physical resources that are ultimately gifts of the earth. Just as the mother gives us life, the earth gives us her hidden treasures abundantly and generously. Small wonder then, that ancient sages of Bharat called the earth Dharti-Ma—Mother Earth. Our mythology tells us of Sita, the earth-child born out of Dharti nine thousand years ago in answer to the prayers of the pious king Raja Janak, and how, after many years and incidents, Dharti Ma cleaved open to

receive Sita back unto herself, in answer to Sita's prayers! For centuries, the earth has been referred to as Mother in Bharat, and any willful destruction or hurt caused to the earth was considered sacrilege; an unpardonable transgression. The great epic Mahabharata recounts how, during the great battle of Kurukshetra, Karna's chariot wheel got stuck in the earth in retribution of his having willfully hurt Dharti in a show of strength in his early youth. And in what could well be a metaphor of our times, Karna paid for that insensitivity with his life.

The story of Bharat goes further back than our epics and myths. Bharat is one of the few civilizations that blended the idea of mother and the land of birth—*Janani Janmabhoomi*. Defending the land is thus synonymous with defending the mother, and this is where land ceases to be just a tangible reality of rocks and soil—it is a persona drawing within itself honor, emotion and passion. Thus in Bharat, land, or Bhoomi has been imbued with a sacredness that is almost mystical in nature. In other words, it has been our tradition to treat land with respect—something that the rest of the world is now waking up to.

The ancient tradition of *Aparigraha* permitted us to draw resources from the earth, but only enough to sustain a comfortable living. The way of life practiced in Bharat was such that the land was not burdened by accrual of waste—a modern phenomenon. It was our forefathers' way of showing respect to Mother Earth. Minimizing wastage was an important part of life: buildings were dismantled not destroyed so that every useable component could be re-used; old clothes handed down to others or exchanged for utensils when they were beyond repair; and when something could not be used anymore, new ways of using it, or parts of it, were ingeniously invented. Even the human body was cremated to return all the five elements—Pancha Bhootas—to Nature,

leaving behind nothing to occupy space except in the hearts of loved ones.

In this ancient land of ours, recycle and re-use have been integral parts of everyday life, leading to a nuanced understanding of Bhoomi, or land. When we approach land-use today, we need to bring to it this nuanced understanding that our forefathers lived by.

Climate Change

Developed and developing nations in the western world, including our next door neighbor, are subsumed in consumerism. Consumerism demands that comfort be provided at any cost—even at the cost of Nature. For more than a hundred years they have overdrawn from the earth to fulfill human greed, not allowing the earth to replenish her natural resources. Human greed is boundless as the sky, and the madness of consumerism in any one nation is enough to set off a chain of events affecting not only other nations, but also every species on earth. Consequently, our land, air and water are heavily polluted. Now, grave danger to life on earth looms large in the shape of climate change. A million species have already become extinct and many more are seriously threatened. Alarm bells are tolling, telling us to act now. Tomorrow will be too late!

All Is Not Lost—Yet

Fortunately, Indian Green Building Council (IGBC) and many other Green Councils of the world have come together, generally supported by their countries, to act on a war footing to stem the impact of climate change. Bharat has committed to the world that all her future development will be eco-

friendly and in harmony with Nature. These are beacons of hope for preserving life on earth, and for the younger generations and generations yet-to-be-born, so that they can enjoy the bounties of Nature as we have in our life-time.

Strategies To Optimize Our Limited Resources

Bharat is at the take-off stage in development. The one-point agenda for the nation is: Development, development and development, in a sustainable manner. The total built-up footprint today is approximately 30 billion sq. ft. Much more needs to be built in order to provide 'Housing for All', workspaces, recreation areas and spaces for other needs.

IGBC research has rediscovered ancient construction practices followed in different parts of Bharat that were based on the climatic conditions specific to the region. The magic of our traditional construction practices that gave our ancient temples, dharmshalas and forts life of a thousand years and more, has been quantified, and this knowledge will be of great use to our architects, land developers and builders. The underlying principles of all our building guidelines are based on reverence to Nature, conservation, recycling, minimum waste generation, and are geared towards better health and well-being of the occupants. This holistic approach is Bharat's unique gift to architectural planning and execution. Some of the common Bharat-centric strategies, applicable to practically all our regions, were evolved and perfected by IGBC. These are discussed in the following section.

Use Of Pozzolana Cement With Fly Ash

The industrial revolution came to Bharat post our Independence and spread its wings in the fifties and sixties.

Steep growth in thermal power plants, steam locomotives and heavy industries that consumed coal at a rapidly increasing rate resulted in mounds of fly ash across the length and breadth of the nation. The Bureau of Indian Standards (ISI) came up with the Code for the use of grey cement (almost banning the use of white cement) by mixing 20 percent of fly ash with cement during the manufacturing process. The National Building Code of India 2005, provides elaborate guidelines for the use of grey cement for a whole variety of concrete strengths. Green Building certification gives due recognition to the percentage of fly ash in the cement, under the Innovation category. Today, we have Green Buildings using cement with 70 percent fly ash. What could have been a humungous production of waste matter polluting the earth was thus effectively put to productive use.

Autoclaved Aerated Concrete (AAC) Blocks

The thermal resistance of air is fully exploited by using molded lightweight aerated concrete blocks, cut to the size of standard bricks, and autoclaved to give compressive strength and maximum usefulness. AAC blocks are used as filler material within the RCC framework during building construction. These blocks used in place of bricks, eliminate not only scouring of the earth for clay to make clay bricks, but also the process of baking in kilns that create extensive air pollution. Moreover, clay bricks are almost transparent to heat transmission, whereas molded AAC block-walls—replacing traditional brick walls—provide inherent thermal resistance. Thus AAC blocks provide a win-win solution. As a bonus, the mounds of fly ash have gone, consumed to make AAC blocks in their place, for local consumption. The builder/developer/owner could still prefer to use traditional familiar bricks, but to sweeten the process of selection,

the price of AAC blocks has become comparable to that of clay bricks. This has been made possible by the ever-increasing demand for AAC blocks for a whole range of built environment, namely - commercial, institutional, industrial, and residential buildings. With the focus on 'Housing for All', IGBC is able to be all-inclusive—catering to the needs of high, middle as well as low income groups—across the length and breadth of Bharat.

Recycled Reinforcement Steel

For all construction using cement in any form, the use of reinforcement steel rods is essential. At the beginning of the Green Building movement in India, all steel manufactures—Tata Steel, Mukund Iron Works, Jindal and Rathi—swore to producing steel strictly from iron ore. IGBC took a firm stand on giving preference and higher ratings to Green Buildings that used a larger percentage of recycled steel—from old buildings, and by dismantling steel structures to make way for new ones. It took considerable persuasion and counseling of steel manufactures to have them mix virgin ore with old steel in the furnaces to produce steel of the finest quality. And now 20% to 30% recycled components have become the industry norm. It has helped both in optimizing the price of steel, and in eliminating piles of rusting, discarded steel—a serious waste problem faced by all developing nations of the world.

New Glass Variants

Despite the generally hot climate and abundant sunshine of Bharat, conventional buildings used window panes of single glass, permitting huge heat ingress into peripheral

indoor spaces. Buildings taller than 15 metres switched over to toughened float glass to prevent injury to passers-by from shards of broken glass in case of accidental shattering. However, local manufacturing of single glass still continued.

The heat-load calculation for the Green Business Centre (GBC) Hyderabad demonstrated a large reduction in air conditioning load and the consequent significant reduction in its annual energy consumption, made possible by the installation of double glass windows or Double Glass Units, (DGUs). Hermetically sealed double-glass windows had to be imported at a staggering cost, for Bharat's first certified Green Building, the GBC at Hyderabad. Sensing the market potential of DGU, all the major glass manufacturers such as Saint Gobain, Asahi Glass, Kolkata Glass and others embarked upon local manufacture of special glass—namely double glass units, low Emissivity glass (E Glass), Light, Heat Reflecting glass (LHR), glass with high Visible Light Transmission (VLT) etc. Green Buildings have thus created a modern glass industry to fulfill a variety of special requirements of a sustainable built environment.

Artificial Wood (NU-WOOD)

One of the seminal contributions of IGBC has been towards retaining whatever is left of Bharat's forest cover. Most builders of the post-independence period vied with each other in the use of Assam Teak, Sheesham wood and other timber sources from the abundant forests dotting our landscape. In order to fulfill our unsatiable hunger for fine timber, we began mercilessly destroying our forests, ignoring the fact that they had been maintaining nature's balance for over a million years.

Our timber companies did not obey the simple direction given by the Forest Stewards Council (FSC)—that as one

section of forest is cleared, new trees are to be planted in another section to always retain and enhance the total forest cover. Our continental neighbors Thailand, Malaysia, Indonesia and others religiously followed these recommendations and have blossomed into suppliers of FSC certified wood to the whole region. IGBC prohibits the use of natural timber from the forests in order to contain rampant felling, permitting only FSC certified wood or artificial wood.

The Ministry of Environment and Forests (MEF) sensed the great danger perpetrated by greedy timber companies, and enacted the environment protection Act. Nature's sentinels, forests which prevent floods and droughts, storms and cyclones, were thus protected by the Law of the Land. The use of timber from forests was made a punishable offence, halting the mad destruction of India's forest cover.

Bharat has always been an agricultural economy. After every harvest, huge amounts of farm waste is left behind. Only paddy is used for cattle fodder, but straw-husk, and other farm waste pose a serious disposal problem. Traditionally, most farmers burn the waste to prepare the land for sowing the next crop, causing massive air pollution. A less polluting solution was required. Indian scientists developed the highly innovative technology of sun drying and high-pressure compression of farm waste to produce artificial wood, called NU-WOOD. The process has been perfected to such an extent that NU-WOOD has all the properties associated with forest timber. IGBC patronizes NU-WOOD. It is in great demand for making window frames, door frames, shutters, laminates, joinery, cupboards, beds, drawers and even furniture for certified Green Buildings. NU-WOOD is a classic case of waste-to-wealth.

Bamboo—The Fastest Growing Plant

Northeastern parts of Bharat provide perfect climatic conditions for growing bamboo. It is one of the fastest growing plants, achieving full growth within five years. Moreover, planting and harvesting is simple, and it requires very little water for growth. Effectively, bamboo plantations do not adversely affect the water table.

For decades, bamboo has been used for traditional homes in the Northeast. The great western architect Laurie Baker perfected its use for homes in the southern regions of Bharat. Extensive research and development has been done on the use of bamboo. It has been used to manufacture floor tiles, false callings, dry partitions, fencing and most extensively in making bamboo furniture.

Prior to the Green Building movement, when bamboo flowered, acres of plantation used to be burnt to make place for the next crop since there was no cost-effective way to transport the huge volumes from fields to the markets. This used to be not only wastage of a resource, but also a major cause for air pollution. To prevent this, factories have been set up near major bamboo plantations with IGBC patronage, and farmers are flourishing through meeting the ever-increasing demands of bamboo products for Green Buildings.

Banning Of Asbestos And Formaldehyde

Indian industry produced and used asbestos sheets and asbestos tiles for sloping roofs on factory buildings and for other purposes. They did not realize that the process of manufacturing asbestos products is highly carcinogenic, until a large number of workers in the asbestos manufacturing plants developed incurable cancer. This led to Indian Parliament enacting a law banning all production and use of

asbestos. Now the IGBC pre-requisite for Green Buildings forbids any use of asbestos for construction.

Similarly, formaldehyde was in use for joinery, furniture and other carpentry work for decades. It has a very high toxin content that heavily pollutes indoor environments, making it dangerous over the long term. Therefore, since its inception, IGBC prohibits the use of formaldehyde as a thinner or adhesive. Similarly, varnishes for furniture and woodwork with high VOC content are not permitted in Green Buildings.

Low VOC Paints

Another great service IGBC initiated for the health and well-being of occupants of Green Buildings has been the control of indoor VOCs. It is well known that when any enclosed space is freshly painted, the smell of paint hangs on for a long time, till it is expelled outdoors or diluted by incoming ambient air. In reality, the smell is not from the paints, but from VOCs present in the paint; these are injurious to health, especially for occupants with breathing-related problems.

From its inception, IGBC has promoted the use of low-VOC paints, for the better health and well-being of the occupants. Initially, paint manufacturers resisted the change. Later, recognizing the huge business opportunities of certified Green Buildings, Nippon Paints became the first major manufacturer of low-VOC paint, followed in quick succession by Asian Paints, Johnson and all others. Ultimately the huge demand for low-VOC paint completely took over the industry. The price of low-VOC paints is lower than conventional paints loaded with VOC. Thus IGBC has been a catalyst in starting a small industrial revolution in the paint manufacturing industry.

Roof Insulation

Traditional Indian buildings provided roof insulation through inverted pitchers to trap the air. Also mud *Phuska*—layer of bamboo shreds mixed with mud—was used to provide roof insulation. This greatly increased the dead weight on the roof of the building, making it feasible only for single-storied buildings.

As an alternative, the construction industry started using expanded polystyrene slabs to provide thermal insulation for roofs exposed to the sun. A problem arose when it absorbed rainwater, adding a large dead weight to the roof slab, leading to the collapse of many roofs. Ultimately a solution was evolved through the use of extruded polystyrene and other closed cell petroleum products that are non-water absorbing. They provide effective thermal insulation and water proofing of the roof. These are covered with mortar and laid at an angle creating a slope for the efficient drainage of the roof, and for protection against UV ray damage to insulation.

The roof surface is covered with thermal insulation combined with waterproofing. We extensively used imported polyurethane blankets, imported from UK, to provide effective thermal insulation and water proofing of roof surfaces. It solves the exposed roof problems effectively and expeditiously. But the cost of imported insulation makes its use economically unviable. Upon IGBC's persuasion, and sensing the humongous opportunity in Bharat, Armaflex agreed to import only the globules and started the large-scale manufacturing of the insulation in Pune. Green Buildings in Bharat have made local manufacturing grow phenomenally, with many indigenous products readily available in all regions of Bharat.

IGBC added cool roofs by laying grass on top, to increase the cooling through evaporation in hot and dry climates.

Broken glazed tiles, thrown away by tile manufacturers, have been ingeniously used to cover the finished roof surface. These provide a highly cost competitive alternative to high albedo paint, used to reflect back the sun's heat and to provide a cool roof.

Greenco Certification

All Green Buildings require the project team to submit a certificate from the manufacturer declaring all the recycled content in their products. IGBC had no mechanism to verify the manufacturer's claim. Also, the embodied energy in the manufacture of construction materials is not available.

The world's most authentic source for material certification is the Underwriters Laboratory (UL). It has an unblemished record of more than a hundred years. Seeing the vast opportunity in Bharat, they opened their offices in Bangalore. Although the initial cost of certification was prohibitive due to the lack of local laboratories, many consultants, like my group, swore by their transparent procedures.

Five years ago, UL held their Board meeting in India. Some of the leaders of IGBC prevailed upon them to work with Indian manufacturers of construction materials, to certify the greenness quotient, through accurate recording of the recycled content and the embodied energy. Our Founding Chairman Parasuraman leads the Greenco certification for IGBC

We now have an authentic certification of green materials and components, and GBC uses this for the assessment of Green Buildings. The success of Greenco has been unprecedented with more than 300 Indian products having been given the rating by UL; many more hundreds are in the pipeline.

Decentralized Manufacturer Of Green Products

CII has been in the forefront in encouraging small scale manufacturing, in support of Mahatma Gandhi's call for cottage industries. Large numbers of active CII members are SMEs with turnovers of less than one hundred crore rupees. CII has created special funds to help start-up groups with promising projects. This initiative has helped dozens of successful SMEs through extended soft loans. Thus, CII fully supports the present government's initiative of encouraging start-up ventures and innovation by Bharat's youth.

All along, IGBC has promoted local and regional manufacturing of green products. This avoids the waste of time and energy in transporting products over long distances, as is the case in western countries. The assessment criteria for Green Buildings prohibits the transportation of green construction materials (except high efficiency equipment and component for building services) beyond a specified distance, currently no more than 300 km. This radius is being brought down as certified Greenco products are made available in all regions in response to our ever expanding demand.

Challenges

There are countless unsung heroes in Bharat who have developed indigenous processes to tackle various problems such as naturally cleaning Sarovars using algae fostered by sun to provide clean drinking water; providing low cost cooling by using clay pitchers; directing sunlight into inaccessible occupied areas; rejuvenating wastelands, and coming up with many other home-grown solutions that are cost-effective.

However, the challenge remains of providing external thermal insulation to buildings that can withstand UV rays, rain, dust and the large diurnal variations in temperature, for a hot country like Bharat. Thermal insulation has to be on the outside but most of the available, affordable materials do not last in our climate. Once developed, this would be the panacea for mass housing for the vast population of Bharat.

Chapter Four

Site - The Space - Gagan

Conservation is a state of harmony between men and land

Aldo Flopuld

I conceive that the land belongs to a vast family of which many are dead, few are living, and countless numbers are still unborn

A Nigerian Chief

In the depth of my meditation, I soar into
The fathomless radiance that floods the cosmos

I tarry at the feet of the great silence
Where the universe offers herself in self-dedication

With clasped hands, I stand under the starry alter and pray
O sun thou hast withdrawn to yourself all thine rays,
Now reveal your most benign form, and let me see Him,
Who is the self-same One in thee and in me.

Excerpts from Tagore's Meditations

Forbidden Sites

Following the collective wisdom of our thought-leaders, IGBC has put several conditions on site selection, especially where buildings cannot get green certification. Land prices have been rising in our metros due to the shortage of available vacant land parcels. However, there are no such conditions on site selection in tier-two and tier-three cities, or in the towns and villages of Bharat, where the majority of future building construction is going to take place.

With the help of satellites, detailed maps of land use are available for all inhabited regions of the world. These maps reveal contours of the land for rainwater flow on a 100m grid, the existence of bird sanctuaries, resting places for migratory birds, mangroves, forest areas, ponds, water bodies, the natural course for rainwater flow, and many other geographical features that affect a region's ecology. The first prerequisite for site selection for IGBC certification is that construction on that land should not negatively affect or destroy the region's ecology. This mandate has been grossly violated in our metros, but IGBC has ensured that green certification will not be given for projects that have violated this basic requirement.

The second important prerequisite is Bharat-centric. Our construction industry is the largest job provider to unskilled labor in the country. This pool consists of villagers who are basically farm labor, employed as contract labor during the harvesting season. For the rest of the year they have practically no work or source of income for their survival. That is the reason they move with their families to nearby towns, cities and metros, and live in slums to find temporary work within our small-scale construction industry. Developers have scant

concern for the safety of the unskilled construction workers and little value for their lives.

IGBC has therefore made a prerequisite that, if any accident occurs at the construction site causing death, that building will not be certified by IGBC. The majority of deaths used to be from falling into lift shafts, or due to electrocution while carrying site-made wet concrete saucers on the head and stepping onto a leaking electric wire. Fortunately, I worked with the Prime Minister of India in the late seventies and got him to make the law that all circuit carrying current upto 3000 amps needed to be backed either by an Earth Leak Circuit Breaker (ELCB) or a Residual Current Circuit Breaker (RCCB). This is a must for all construction work at site, and later in every final distribution board in the building operation. These circuit breakers are locally manufactured all over Bharat and have now become very inexpensive. They have effectively saved thousands of poor unskilled workers from fatal accidents.

The above being the prerequisite for IGBC green certification, these are specified for every single IGBC certified project. Over 5000 projects from all parts of Bharat are testimony to IGBC's great presence in improving our standards voluntarily, instead of depending upon the inspector's biases that could lead to irregular practices.

Pre-Independence Bharat – Brown Field Sites

Pre-independent Bharat had textile mills in metros like Delhi, Bombay and Calcutta, and also in the tier two cities of Ahmedabad, Baroda, Pune and others. These were located in the heart of the cities, so that large numbers of workers could walk to work, or come riding a bicycle for short distances. Similarly other small scale and light

industries, which were labor intensive occupied prime land in the cities. Heavy industries like steel manufacturing, car manufacturing and assembly, two-wheeler manufacturing etc., were located in towns that developed around those manufacturing plants.

With growing population, the pressure on land within the cities began to increase to cater to commercial, institutional and high-end residential accommodations. Land prices in metros and in tier two cities kept rising, making the large parcels of prime land occupied by industries most attractive for builders and developers. Local government policies also helped in forcing the industries to move out to industrial areas outside the cities, to minimize air, water and noise pollution. But these industries left behind heavily polluted land through leaking of acids, chemicals, solvents and contaminated process effluents.

By the turn of the century, most textile mills in the metros had closed and prime land was sold by the owners to developers and builders at high prices. IGBC has worked closely with our country's premier organizations, Central Pollution Control Board (CPCB), CSIR, Agricultural Research Institute, Agricultural University, Soil Research Institute and others, and these institutions have developed detailed guidelines towards sanitizing and resurrection of soil afflicted by industrial contaminants.

During assessment of new projects on erstwhile industrial sites, IGBC gives awards and special considerations to projects that have carried out recommended measures to resurrect and sanitize the soil (sometimes up to a depth of 8 to 10meters) in brownfield sites.

One of the most inspiring projects on brownfield sites is green industrial townships that have been completed in the last twenty years on wasteland in the Kutch region of Gujarat.

In the scoreboard of the registered green footprint with IGBC, brownfield projects add up to a very tiny fraction; the overwhelming majority of green projects are on healthy sites.

Healthy Sites For Green Buildings

IGBC has prepared detailed guidelines for green site development for each of the 22 building applications, namely: residential, commercial, institutions, industrial, recreational, mixed-use development, and for infrastructure projects like transport, MRTS, railway stations, landscape and others. There are several common guidelines for green site development for all IGBC certified green projects, both for green infrastructure and Green Building applications. These apply equally to healthy sites and to sanitized brownfield sites.

Common IGBC Guidelines For All Green Site Development Work (Green Infrastructure and Green Buildings)

The Guidelines lay out clear terms and conditions as follows:

1. **Barricading** part of the construction site, including authorized stacking ground space for construction material adjoining the construction site, is mandated in order to avoid disruption of normal traffic around the construction site. Alternative provisions have to be made to ensure minimum problem is faced by large and small vehicles, as well as pedestrians.

Barricades are made of reinforced galvanized steel sheets, rigid reinforced FRP roofing sheets, or marine plyboard sheets, generally 6m in height. These are mounted on a galvanized steel or aluminium pipe framework to provide rigidity against impact and wind loads. Tall hinge doors are

provided in the barricading to permit vehicular movement for plying construction material and for any construction waste to be carried out. Tyres of those vehicles are washed inside the barricading to prevent carrying mud and dust onto public areas/roads. Smaller doors are also provided in the barricade for workers.

The main objective of barricading is to minimize the nuisance to neighbors from the noise, falling rubble, and dust arising from the construction; the site is regularly sprinkled to contain dust from being blown all around.

2. **Rainwater harvesting** is provided at the site by digging a shallow pit (less than 1-2 m deep at lowest point to prevent accidental drowning) inside the site itself, outside the area of construction. The sides and bottom of the pit are covered with a layer of geo-membrane to prevent seepage. The sidewalls and top edges of the rainwater harvesting pit are provided with stone pitching, using pebbles to arrest debris from falling into the pit. It acts as a settling tank and clean water is drawn from the upper levels of the pit. This water is primarily used for sprinkling the site and to wash the tyres of vehicles leaving the site. In summer and winter, the rainwater harvesting pit is charged with ground water that is used for construction activity.

3. **Water for construction** is provided by municipalities, at a price higher than the domestic tariff, for any construction work carried out within municipal limits. The quantum of construction water sanctioned by the municipality is as per the guidelines in the National Building Code of India, currently in its fourth edition, as NBC 2016. The additional requirement for construction water, if any, for buildings within municipal limits, and the total requirement of

construction water for buildings outside the municipal limits is met through groundwater. Written permission is obtained from the construction authority and a shallow bore-well is dug, of only 5-6m depth from the ground level, but not to the first aquifer. This shallow wellwater is not fit for human consumption; it is sealed off when the construction work is over. New permission is required for providing a deep bore-well up to first or second aquifer for domestic water supply for the occupants if municipal water supply is not available because the site is outside municipal limits. Incidentally, municipal water supply for occupants as per NCB 2016 is quite generous. IGBC certified buildings normally consume only half or one-third of the permissible municipal water supply for both residential and commercial projects.

4. **Topsoil preservation** has been an excellent initiative, strongly recommended by IGBC right from its inception. Bharat is an agricultural economy. Most new construction activities in tier two and three cities and in towns are on land that has been used for agriculture. Such land has seen years of rain and sunshine, has roots from sowing and harvesting, and is rich with nutrients that have made it fertile.

Therefore IGBC recommends that for all new construction (except for remodeling or renovation of existing buildings), the top 300mm of soil has to be stacked on site (outside the construction zone) or at a nearby convenient location, and it has to be regularly mulched and turned over to retain its fertility. At the end of the construction activity, this fertile soil is used to cover the finished ground on the site to provide an inexpensive ready-made solution for beautiful landscaping, flora and fauna and biodiversity for the built environment.

5. **Construction waste recycling** is another major contribution of IGBC towards environmentally responsible construction activity. The last fifty years have seen two new Bharat's added to our total built footprint making it three times the original footprint after Independence. Before IGBC and our persistent initiatives, construction waste (in the first thirty years) was handled in the most irresponsible manner. Due to rapid urbanization, these construction activities took place largely in our metros and cities such as Cochin, Bengaluru, Hyderabad, Secunderabad, Ahmedabad, Indore, Raipur, Gurgaon, Noida, Faridabad, Pune, Nasik, Jaipur, Chandigarh and others.

The most unfortunate part is that most of the builders and developers, even Govt. agencies like DDA, MCD, BMC and others have taken no responsibility for the disposal of construction waste. The easiest way to make it vanish had been dumping it into the nearest Sarovar, pond, canal, or even perennial rivers, causing irreparable damage to the ecology of the region. The classic example of this ecological havoc is the nation's capital Delhi, where 1000 waterbodies have shrunk to less than 100, same is the fate of Bengaluru. But all is not lost!

IGBC has laid firm guidelines for converting construction waste to wealth. For any IGBC certified Green Building, PM/CM or the owner is required to keep an authentic record of the number of trucks leaving the site and the method of disposal of waste. Strict guidelines are laid out that all recyclable waste has to be sold or donated. For example, excavated earth is donated to developers working to fill up low-lying areas or to municipalities for road construction. Paper, Thermocol packaging, cardboard cartons, timber, broken glass, and leftover reinforcement steel bars are sold to recyclers and receipts are maintained. The trucks carrying toxic waste are permitted to dump it only in authorized

areas. The stone chippings are reused on site to make grass pavers, leftover plastic is used to make driveways and parking lots within the site. Architects have evolved amazing usage of all construction waste so that a million square feet of platinum green commercial complex has less than 10 trucks of construction waste leaving the site for authorized dumping grounds.

IGBC stands as a beacon of hope as Bharat re-adopts Green as a way of life. Our perennial rivers will rejuvenate themselves with fresh monsoon rains, and our younger generations will be able to drink water from these perennially flowing rivers.

6. **Public transport** is the preferred mode for commuting long distances; information technology has been another major contribution by IGBC. A necessary byproduct of urbanization is long distance commute by millions of people going to work and returning to their homes in the outskirts of urban centers. Developed countries paid scant attention to this because of fossil fuels being locally available, or inexpensively procured, ignoring the massive carbon emission resulting from that transportation.

Bharat has chosen to enhance the convenience of commuters through public transportation. All metros and many tier one cities have good bus services within the city. Mumbai took the early lead in connecting Western railways from surrounding suburbs to Mumbai. But the most outstanding example of a successful government owned transportation is the Delhi Metro Rail Corporation (DMRC). They have changed the face of Delhi in the last twenty years. As per their records, three million people come to Delhi every morning by DMRC, going to work, and leave every evening for their hometowns in areas surrounding Delhi. Delhi Metro's on-time performance is legendary. Fortunately,

the nodal ministry of Government of India, Ministry of Urban Affairs has accorded them the highest recognition for their stellar performance. IGBC is privileged to have been a partner with DMRC in developing IGBC Green MRTS rating, the first of its kind in the world. All of the DMRC Metro stations, both new and existing, are vying for IGBC's highest Platinum rating—a glorious contribution to the Green Building movement in India. With multiple Metro lines now operational, every part of Delhi, Gurgaon, Noida and Faridabad are interlinked by DMRC.

DMRC's successful accomplishment is being emulated by cities across Bharat and DMRC is offering consultancy on how to go about it, as well as guidance on how to explore IGBC's greenest platinum certification from the inception stage of its design.

In order to reduce the burden on our meager resources, IGBC has laid out the following guidelines.

- The majority of construction workers will walk to work from nearby labor camps and these temporary places of accommodation are to be arranged by the builder.
- Groups of construction workers for commercial, institutional, recreational and industrial buildings will commute by CNG powered vehicles arranged by the employer.

7. **Worker safety** measures have been clearly defined to make IGBC all inclusive. It has helped millions of unskilled construction workers live with dignity, work in a safe environment and return home in the evening to their loved ones, living beyond mere existence. Some of the measures enforced by the IGBC are as follows:

- For any site employing women, a mobile crèche has to be provided for the workers' children. Children are not allowed to enter the construction area.
- Mobile toilets for men and women have to be provided in one corner of the site.
- Adequate drinking water supply is to be made available near the toilet, in order to keep all wet areas together.
- No worker or even supervisor/visitor (however important) is to be allowed on the site without wearing safety footwear and a hard hat/helmet.
- The entire construction site power distribution and lighting has to be in conduits, and connectors are to be used for all jointing. Every single power point and light point has to be earthed, backed up at the distribution board by ELCB or RCCB. Thus electrocution at the site has been totally eliminated.
- Double ladders shall be used for working at a height up to 4 meters. Beyond 4 meters, safety harnesses and tackles are mandatory to arrest accidental falls. We now have IGBC green certified mega projects which display at the entrance 3-4 million man-hours with 0 major accidents leading to injury. This has helped us to ensure that construction workers return home in the evening singing, rather than moaning and groaning.

We can now boast that IGBC has made the Green Building movement in Bharat all-inclusive, with millions of migrant unskilled construction workers reaping the benefits of better health and assured safety.

Additional Common IGBC Guidelines For Site Development – only for Green Buildings

(applicable to green Infrastructure projects)

1. **Municipal or statutory authority sanction** of building construction drawings is a prerequisite for IGBC evaluation of Green Building design. This sanction implies that the proposed building design complies with the norms of fire safety, structural safety, human safety, access and parking requirements as defined in NBC 2016, MOFE guidelines, the CPCB norms and local bylaws. IGBC has no expertise in these compliances. Hence sanction of construction drawings fulfills the need.

2. **Access to public transport** within walking distance is an important consideration for all Green Buildings. A reasonable walking distance for all age groups in Bharat is considered to be 800m. Therefore, within 800m of a Green Building, one of the following public transport facilities is desirable:

- An electric or CNG driven bus stand.
- A stop for buses providing last-mile connectivity to Metro stations.
- A Metro station.
- Road transit or rail system.
- A shared-taxi stand for Ola, Uber and other public service providers.
- A shared-three-wheeler stand

Electric golf carts providing complimentary service to important buildings inside large campuses such as in universities, IITs, IIMs, etc.

In remote locations, where public transport is not economically feasible, the employer is requested to provide CNG driven buses for workers with pre-designated pickup and drop-off points in residential areas. Senior officials are advised to use car-pooling to reduce the burden on fossil fuel and reducing CO2 emissions.

3. **Public conveniences** play an important role in urban life. IGBC has prepared an exhaustive list of public conveniences regularly used in urban areas. Some of the more important ones are:

- Eating joints like Starbucks, Café Coffee Day, Barista, McDonald, various restaurants and fine dining outlets, etc.
- Recreational facilities - theatres, movie halls, multiplexes, public parks, facilities for outdoor games, gymnasiums etc.
- Free Wi-Fi connectivity stations.
- Free mobile charging stations.
- Public Toilets.
- Grocery Shops.
- Laundry
- Shopping area for essentials
- Pharmacies.

There is a large number of mixed-use development projects, many already operational, where vehicle traffic is confined to the outer periphery of the building, with parking in the basements. Thus the entire area is for pedestrians and vehicles are used only for long distance commuting outside the complex.

4 **Diversion of municipal services** crossing the site (if any) is essential before starting construction work at the site. For large scale mixed-use development projects, it is often the case that one of the following municipal services crisscrosses the site:

- Pylons carrying Hi-tension wires for Grid power supply.
- Natural rainwater flow through the site from adjoining higher areas to further low level areas.
- Municipal water supply trunk mains.
- Municipal sewer disposal trunk mains.

The sale of such land parcels makes it obligatory for statutory authorities to divert these services to the periphery, or totally away, from such sites. The process is time consuming but if the action is initiated immediately on the procurement of such land, the task gets completed before the planned date of commencement of construction work at the site.

IGBC certifies such projects only after these services are diverted; alternatively, clear landscaped passage is left along these services, with the width of the passage as per statutory guidelines for the safety of the occupants and for protecting these services from accidental damage.

5. **Bhoomi Puja** is a centuries-old tradition in Bharat. Irrespective of the religious preference of the developer/builder/user, we are all united in this beautiful ritual.

6. **Heat island effect** is the peculiar problem with Bharat's predominantly hot climate in almost all parts of Bharat, except in the northern region of the Himalayas. With our

long hours of sunshine and high ambient temperatures, all paved/concreted areas on the ground create heat islands, with temperatures ranging from15 to 200 C above the ambient. These hot surfaces radiate heat back to the building and to adjoining buildings, even long after the sun has set, thereby increasing the air conditioning load and corresponding energy requirement. Therefore, this heat island effect has to be eliminated or at least minimized.

Our NBC and local bylaws define the maximum ground coverage permissible for different locations, different sizes of plots, and different applications. By and large, the common denominator is 70% ground coverage, leaving 30% of the plot area for setbacks that are required for firetender movement, for surface parking of vehicles, for providing sewage lines laid in slope for gravity-enabled flow to the main manhole, for earth pits, for lightning protection, grounding pits and other services.

IGBC has perfected an inexpensive, easy-to-implement solution for minimizing the heat island effect. A 150 mm thick layer of fertile soil (recovered topsoil from the site) is to be spread on non-constructed areas, with pavers mounted on grass in areas subject to regular traffic. These pavers are designed to carry the dynamic load of vehicles like buses and cars. Provision for the movement of fire tenders is made by providing concrete slabs designed for a 45 to 50 ton load; these are to be covered in 150mm grass. It is accepted that in case of a fire this grass will be destroyed, and will have to be planted again.

7. **Transplanation of any fully grown tree/s affected by construction**. The Forest department has laid strict guidelines to prevent the cutting of trees in urban areas. There are many instances where fully grown trees cover part of the

construction site and cannot be retained. The art of removing these with their essential roots intact, and transplanting these on the boundaries of the site, or to an adjacent site, has been perfected to the level of nearly 90% success rate. If a tree cannot be saved and the forest department gives permission to cut it, the developer is required to plant 5 to10 new trees on land designated by the forest department.

The project team is required to submit full details of on-site trees with photographs, along with the Forest Department's approval when applying to IGBC for certification.

8. **Landscaping** of the site has to be provided with native trees, shrubs, flora and fauna, which have survived decades of draught, floods, rain and sunshine. Ornamental landscaping with imported or non-local elements is discouraged.

9. **Prevention of night pollution** is a delicate subject and IGBC has adopted strategies to manage it right from its inception. Urban areas in countries like Dubai and Singapore, even parts of Mumbai and NCR light up the sky at night, and the night-glow is perennial. Focus lighting, facade lighting and street lighting contribute to this issue. It is well known that birds have a 12-hour-sleep and 12-hour-waking cycle. When darkness descends, they fly to their nests in trees or building overhangs. But if the night sky is brightly lit, birds cannot sleep and eventually perish. If this is not checked, younger generations growing up in ultra-modern urban areas may never see a bird.

IGBC has laid clear guidelines on facade lighting, landscape lighting for buildings and external lighting as well as for street lighting. All these lights should be focused to light the ground, creating pools of light with negligible skyward spill. Therefore, all our 5000 registered and certified

green projects ensure zero night sky pollution. As the reach of IGBC spreads, Bharat will be seen by astronauts from outer space as a dark continent like Africa, Canada, Australia and others.

The greatest gain will be that our younger generations and generations yet-to-be-born will be able to enjoy the immense variety and beauty of our common Indian birds such as peacocks, sparrows, parrots, koyals, mynas, eagles and crows.

Chapter Five

Indoor Air Quality (IAQ) - Vaayu

On such a day amidst the winds
Behind their wings,
Let me find my peace
In thy presence.

*

The wind is up, I set my sail of songs,
Steersman, sit at the helm
For my boat is set to be free
To dance in the rhythm of the wind
And water
The wind is stirred into the
Murmur of the music
At the time of my departure
Steersman, sit at the helm.

Rabindranath Tagore

Health And Well-being Of Occupants

One of the most important aspects of any built area is the quality of indoor air—life source of its occupants. Most Green Buildings' design, construction and operation optimize the physical and natural resources for built environment through conservation, recycling and minimizing waste. These result in minimum environmental impact, but its occupants do not benefit directly from these.

The only Green Building strategy that has direct impact on the health and well-being of occupants is in the optimization of Indoor Air Quality (IAQ). It is well established that a human body can go for a month without food, and a week without water. But regular air supply is essential for survival. Therefore, IAQ importance is above all other green strategies.

IAQ Standards

World-wide the most adopted standards for air-conditioning, heating and ventilation are those specified by the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).

American Society of Heating and Ventilating Engineers started in the mid-1890's in New York. Over the years, it merged with the American Society of Refrigerating Engineers, eventually to expand into ASHRAE, in the middle of the twentieth century. In its current avatar, ASHRAE does extensive research in universities across USA, with the help of Industrial Grants and University Endowments.

For fifty years and more, many university campuses have thermal environment chambers with variable controlled environment which can be set to desired indoor temperatures, relative humidity and fresh air input rates. Most of these campuses have students from various countries and these

students belong to all age groups. They are provided with a small financial reward for stating their comfort perception, on a scale of 1-10, for various controlled indoor environments provided. These ASHRAE findings are published in the ASHRAE Handbook of Fundamentals, which is valid for four years. Every fifth year, ASHRAE's four handbooks are updated and these are considered to be the world's most updated authentic source of scientific data for HVAC and R professionals. ASHRAE IAQ Standards are published as standard ASHRAE 62.1; it is the most debated standard in the industry. The obvious reason is the vastly different climates of the cold western countries, compared to hot and humid climate of Bharat and other tropical countries; reason why one solution does not fit all.

I have had the privilege of being a founding member of the Indian Society ISHRAE, created on the lines of ASHRAE. It operated from my home in New Delhi for the first five years and has since grown from 100 to 20,000 members. ISHRAE publishes Bharat-centric handbooks and specifies Bharat-centric standards.

Recently ISHRAE has published IEQ standards for Bharat. It has been hailed by ASHRAE, BIS, BEE and has also been adopted by IGBC. This has been prepared by our country's most eminent industry professionals and brilliant academic minds. It forms a part of NBC 2016, for which I have had the privilege of being the Convenor.

ISHRAE IEQ Standards

The brilliant minds of ISHRAE joined forces to draft the IEQ Standard going beyond ASHRAE. We realized that there are three major factors in the environment of occupied spaces that can enhance the health and well-being of occupants of

Green Buildings. These factors in the order of priority are listed below.

IAQ

ISHRAE set out to define Bharat-centric indoor air quality standards on the basis of our five climatic zones and the levels of activities of the occupants. These form part of Chapter 8 of NBC 2016 and these are widely adopted by architects, consultants, designers and academicians throughout the country.

Since smoking is prohibited in most parts of the world to avoid harm from secondhand smoke, the IAQ standards have been diluted considerably since the 70's. However, the current standards fully address the Sick Building Syndrome which was a result of minimum fresh air intake, that had been implemented to ward off the global energy crisis of the late 70s and early 80s.

IAQ Standards in the NBC 2016, taken from ISHRAE IEQ Standards, give a comprehensive table of fresh air requirements for the whole range of applications. Broadly fresh air quantity is prescribed in the range of 7.5 to 10 CFM (13 to 17 CMH) per person, with a correction factor for the level of activity of occupants.

1. Heat Recovery Systems

USA and most European countries have predominantly cold climates with mild brief summers and ambient temperatures ranging from high twenties to mid-thirties. However, the scenario completely changes for tropical climates such as Bharat, where winters are short but summers are long and very hot with ambient temperatures ranging from low to

high forties. Therefore, every ounce of fresh air brings heat and humidity.

My advisor at the University of Minnesota, recognized my devotion and love for my country, Bharat. He advised me to do extensive literature survey on Heat Recovery Units (HRU) then available, for my Master's degree in Mechanical Engineering. It led to my abiding interest in development of HRUs for tropical climates. Ultimately my doctoral dissertation was on adiabatic heat and moisture recovery units using a silica gel Nano coating on slow rotating wheels.

The basic principle was that part of the return air (10-15%) from conditioned spaces, at 24-260 C, passes over a slow moving (6-7 rpm) wheel, with a coating of less than a few angstroms. It pumps its cool energy into the hot and dry outdoor air entering from the other side, and gets exhausted. The micro site of coating ensures that VOCs, or even viruses and germs do not enter the outside air. Cool (within 2-30c of return air) and dehumidified outdoor air enters the air terminal unit, is mixed with the (85-90%) return air and goes through the process of cooling and dehumidification across the terminal unit. Energy is conserved by the reduction of temperature and relative humidity of the outdoor air.

Thanks to the vision of my legendary advisor, Dr. James Leroy Threlkeld, and my total dedication to Bharat (seeking no financial gains from my research at the University of Minnesota), Bharat has become the principal manufacturer of Heat Recovery Units. Umpteen Indian industries have made their own developments and are now even exporting HRUs across the globe.

Virtually all IGBC certified Green Buildings use HRUs for tempering of outdoor air, leading to 10-15% energy conservation that is precious for the limited power generation capability of our country.

2. Demand Control Ventilation (DCV)

A majority of commercial, institutional and recreational built environments have widely fluctuating occupancy throughout the day and on weekends. Therefore, IGBC has perfected demand control ventilation for certified Green Buildings.

The principle is to continuously vary the quantity of tempered fresh air (TFA), in direct proportion to the occupancy. Occupancy is indicated by the amount of CO2 in the return air stream, which automatically adjusts the motorized fresh air damper in the terminal unit, supplying cool and dehumidified air to the conditioned spaces. It has been found to save in excess of 10% energy for the system.

The good news is that automatically controlled tempered fresh air motorized dampers have become part of the commercial manufacture of terminal units, with affordable costs, and require only a few months for the recovery of the investment.

3. Polluted Outdoor Air

Most Indian cities and towns suffer from heavily polluted outdoor air. It is caused largely by coal-fired thermal power-plants belching out smoke, by the burning of farm waste after harvesting, and by urban areas exponential use of fossil-fuel (petrol, diesel) powered vehicles. Urbanization brings migrant workers to cities in search of work, and this adds a huge number of vehicles for public transportation. Delhi Metro has logged three million workers commuting to Delhi every day, yet the number of vehicles on the roads of Delhi, are constantly on the rise.

Bharat has 29 (and more) states and 7 union territories with their own governments. Hence it is not possible for

the Central Government to issue directions to them to not burn farm waste. There are no partitions in the sky and the prevailing winds carry heavy pollution caused by the burning of crops even in the neighboring countries like Bangladesh and even China. In the process Delhi, the capital of Bharat, is rated amongst the world's most and worst polluted cities.

The Government of India has initiated a massive program for the generation of power from clean resources, largely solar, supplemented by wind energy in the coastal areas and from biomass (city waste). Thermal power plants are required to treat emissions; no new mega thermal power plants are being planned. Ring roads circling urban areas are being constructed so as not to permit long distance freight trucks to enter cities. Cleaner fuel, like CNG is being made mandatory for public transport. These measures will eventually diminish the pollution in cities, but these are still too few.

Some IGBC visionary leaders are developing highly innovative techniques for cleaning ambient air by using the ancient science of Ayurveda. Commonly available plants are being used to remove pollutants like ozone, benzene, toluene, and others. Air is passed through an outdoor air washer (washed with RO water and tempering through thermal wheel) into greenhouses filled with plants like Sansevieria, Erica Palm, and Money Plants among others. The results are spectacular; most of the pollution hits the surface of the plants and fresh air like that of mountain areas enters the terminal unit, thereby promoting the health and well-being of the occupants.

4. Indoor Pollutants

Most of us experience everyday indoor air pollutants. These come largely from VOCs being emitted by formaldehyde, glue and varnishes used for furniture, from carpets and rugs,

from linen, towels and dusters, and the major amount comes from indoor paints.

IGBC has done yeoman service for the health and well-being of occupants through the banning of formaldehyde etc., through the use of carpets and tiles manufactured by recycling of non-VOC fibers and through market transformation by inducing major indigenous paint manufacturers to manufacture Low VOC and no VOC paints. Realizing the enormous potential of Green Buildings in Bharat, most reputed paint manufacturers like Nippon Paints, Asian Paints, British Paints, Johnson, and others have completely switched over to Low VOC paints. In fact, in fifteen years, the old conventional paints, chemicals and varnishes, full of VOCs, have virtually disappeared. The demand for low VOC paints has had a cascading effect and today these are industry standards with affordable prices.

Modern commercial buildings and many residential ones are equipped with copying machines, reproduction machines and printers, all of which emit ozone. Therefore, the standard practice in Green Buildings is to club these together, provide tempered fresh air (no return air) in that area, and remove the polluted air through special carbon filters, straight outside and away from fresh air input areas of the building.

Similarly, effluents from commercial kitchens, laundries etc., are taken outside through dry or wet RO water scrubbers, maintaining negative pressure indoors to minimize indoor air pollution.

5. Lighting

There is distinction made in lighting requirements also.

- **Day lighting**: One of Nature's blessings for Bharat is abundant sunshine, of at least 300 days every year in

> practically all parts of Bharat. We worship the sun as Shakti-Punj, the source of inexhaustible energy. Worship of the rising sun is a centuries old tradition, passed on from rishis to the common man. Every morning hundreds and thousands of young and old alike walk in parks, practice the Surya Namaskaar, and pray to Surya the Sun God as an early morning ritual.

IGBC has perfected the design of fenestration to bring daylight to every nook and corner of a certified Green Building, without the glare and without adding solar heat to the built environment. Excellent computer simulation programs have been developed for Bharat's five climate zones and for the vastly varying diurnal cycle. Over the years, these computer simulations for certified Green Buildings have become industry norms. These are available at highly affordable prices, for use by architects, consultants and green consultants. Green homes and green residential projects do not require any simulation, making it easy for home-owners to adopt IGBC strategies, without engaging architects and or consultants.

- **Artificial Lighting:** NBC 2016 contains comprehensive tabulation of artificial lighting lux levels for practically every type of application. These are Bharat-centric, and generally lower than the western standards.

Artificial lighting is a necessity for working, playing and living beyond the sunlit hours and for cloudy monsoon days. In order to conserve energy, IGBC has developed inexpensive lux controlled dimming applications to maintain desired lux levels indoors, only in the occupied areas (through occupancy sensors) of commercial, institutional and industrial buildings.

- **LED Lamps For Solid State Lighting:** The last twenty years have seen a quantum change from GLS and florescent lighting to solid state lighting through LED bulbs. These have a lifespan higher than GLS, fluorescent and compact florescent bulbs, and consume only a fraction of energy for the same lux level, leading to enormous savings, especially in residential applications.

These LED bulbs, manufactured in China and other countries come with a potent danger of blindness, caused by their incorrect color rendering index (CRI) due to cheap manufacturing processes involved. ISHRAE has defined the correct CRI for LED bulbs, but these have to be imported from Europe, USA and other countries at a substantially higher cost. Thanks to the service provided by Energy Efficiency Services Limited (EESL), the joint initiative of UN and the Ministry of Power, Bharat today has become the world's leading user of LED bulbs. EESL provides performance contracting to municipalities, towns and cities across Bharat, changing outdoors, street and security lighting to LED, without any cost to the user organization. The huge savings accrued by high efficiency solid state lighting is shared by EESL for a reasonable return on their investment (ROI).

6. Acoustics

The third and relatively more difficult aspect to control, is the acoustics of indoor environments. Most metros, cities and towns have high ambient noise levels due to street traffic that is present almost round the clock. It is relatively more expensive to provide hermetically sealed double glass units (DGU), except in high-end commercial establishments. NBC 2016 has a full chapter devoted to acoustic control and

ISHRAE has wisely tweaked these methods for all variety of built environments at affordable prices.

IGBC Health And Well-being Rating

This well-being rating for occupants of certified Green Buildings has been prepared by Bharat's most eminent professionals. It is slowly gaining ground to showcase how the occupant's health and well-being can be optimized through ISHRAE IEQ standards. After its success in commercial buildings, this rating, the only one for occupants (not buildings) is being modified to the residential built environment. We are all willing to go the extra mile to ensure that our children and their children live a healthier life and enjoy the bounties of Nature as we have done in our lifetime.

Chapter Six

Energy Conservation - Agni

Free me as free is the forest fire,
as is the thunder that laughs aloud
and hurls defiance to darkness

O Fire, my brother, I sing victory to you.
You are the bright red image
of fearful freedom.
You swing your arms in the sky,
You sweep your impetuous fingers
Across the harp string,
Your dance music is beautiful,
When my days are ended
My body will be One with You

—Rabindranath Tagore

Energy Consumption

Our world has highly inequitable energy generation and energy consumption. USA leads in the consumption of energy with the African continent consuming the least.

Till recently, villages and remote areas of Bharat had no access to power supply; our per capita energy consumption used to be about 5% of the energy consumption of USA. With the present Central Government's push to supply power to every nook and corner of Bharat, including the last mile connectivity, our per capita power consumption has nearly doubled. The challenge is not to let it go much higher since grid connectivity to these villages and remote areas, where the population is only a few thousand, is economically not viable. The government has wisely chosen to create self-contained solar parks for each cluster of villages. The stored solar power available after sunset has done wonders for our less privileged brothers and sisters.

USA and many other western countries over consume energy because of low power tariffs, abundant availability and their culture of comfort at any cost. But Bharat does not have, and hopefully will never have this luxury. Until recently, Bharat's major power generation has been largely from highly polluting coal-fired thermal power plants, backed up by a small percentage of hydro-power generation.

Solar Power Generation For Bharat

With the price of solar power generation going down exponentially in the last ten years, the Government has aggressive plans to build mega solar parks. Bharat with its abundance of sunshine throughout the year has committed that most new power generation will largely be from solar

energy, backed up with wind energy in coastal areas. the nation is committed to meeting 20% and more of its power demand through clean renewable energy. With this, Bharat will become one of the largest producers of clean power. It will fulfill our aspiration of providing housing for all. The immediate benefits would be that our present 15-20% transmission line losses due to our antiquated power distribution system, would reduce to global norms with decentralized power generation from renewable sources.

Thumb-Rule For Energy Consumption Based On Experience With NASA

I had the great privilege of learning air conditioning system design from my legendary teacher at the University of Minnesota who was also a consulting engineer for some highly complex projects throughout the 60s. Being his blue-eyed boy and driven by a passion for perfection in design, he gave me the lifetime opportunity of working with him on the NASA Apollo program for Neil Armstrong's maiden flight to the moon. And what a glorious experience I had with the project where safety and communication were the most fundamental essentials of the design. Using Ayurveda's ancient wisdom, we also included the Sansevieria and Mother-in-law's Tongue plants in the cabin to ensure Oxygen generation during orbit when the spacecraft was not facing the sun. Thus, I can boast amongst men that my Bharat also made a small contribution to the flight to the moon and in Neil Armstrong's inspiring words 'That's one small step for man, one giant leap for mankind'.

In most of the designs, I was involved in with my Professor and with the architectural organization of Ellerbe and Associates (famous for healthcare designs), energy was

not the concern. The thumb-rule for energy consumption was an average of 20W/sq.ft. built-up area.

My Early Consultancy In Bharat With Architects Stein And Doshi

Immediately upon my return to my country in 1960, IIT Kanpur, Bharat's premier technology institute at that time, funded in collaboration with the famous MIT of USA, invited me as a Professor in the Mechanical Engineering department. The assignment was to teach M.Tech and Ph.D classes and set up a thermal environmental laboratory for research, similar to the one at my alma mater University of Minnesota. It was highly fulfilling professionally, but emotionally very draining. My main reason for resigning from the Carrier Corporation RDC, was to be with my ageing mother and father; they were in their late 70s and could not relocate away from Delhi. Therefore, I resigned and returned home; my soulmate Renu gladly and fully supported my decision.

We moved back to Delhi during the latter half of 1960. I was very fortunate that Bharat's leading architect Joseph Allen Stein offered me to head his in-house MEP Design Group. Later the greatest Indian architect Dr. B V Doshi became his partner. I designed some of my finest projects in the country in collaboration with Stein and Doshi. Based on my experience in the States, the ballpark figures I arrived at was power requirement of 20W/sq.ft. of built-up area, with half of it allocated to the central air-conditioning system. The air conditioning load was estimated at 200 sq.ft. of conditioned area/Ton of Refrigeration (TR).

As I got deeper with the detailed MEP design for each project, I realized that these thumb-rules were very much on the higher side. Leading manufacturers of air conditioning equipment, such as Carrier, Trane, York and

others had developed energy efficient centrifugal chilling machines to replace standard reciprocating machines. This reduced the power requirement for air-conditioning systems, especially for water-cooled systems (for Bharat's hot and dry climate), which could be brought down to almost half of the above thumb-rule for air-conditioning. We specified imported thermal insulation with inherent waterproofing for roof surfaces exposed to the sun. Stein and Doshi's architectural designs provided the least amount of glazing, and specified imported double glass units (DGU) on the west orientation.

My earlier designs used the following modified thumb-rules to arrive at ballpark figures for their mega projects:

- Power : 12 W/sq.ft. of built-up area, with less than half for the centrally water-cooled air conditioning system.
- Air conditioning Load : 300 sq.ft. of conditioned area/ TR

The Hyderabad Chapter

Because of my love for Hyderabad, I entered the limited competition (for the first and only time in my career) to design MEP services for the heritage AP State Assembly Building. Our solution was tailor-made specifically for that building's architecture, and did not disturb the exquisite interiors. We won by leaps and bounds. I worked with the State architect Raghukul Prasad, whose profound knowledge grace and warmth still live in my heart. And together, we worked on the Nizam's Palace, Jubilee Hall, Osmania University Staff Quarters, Nizams Institute of Medical Sciences and many other projects. With each assignment, my love for Hyderabad grew.

A landmark assignment that I am proud of being a part of, is UNESCO's International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). UNESCO chose the outskirts of Hyderabad to set it up. Two of the master architects of our generation, Joseph Allen Stein (who made India his Karma-Bhoomi for sixty years) and Dr. B.V. Doshi got together to win the coveted assignment. And a masterpiece was created during the late seventies—-strictly in harmony with the Pancha Bhootas. This was to be a repository for seeds, at various stages of germination, imported from all over the world. The MEP systems had to be fail-safe. My credentials of having worked with my professor on NASA's Neil Armstrong's maiden flight to the moon were accepted, rather welcomed, by UNESCO. Working with the world famous architects Stein and Doshi was like accompanying Ustad Ali Akbar Khan and Pandit Ravi Shankar for their Jugalbandi. I poured my heart out and I am deeply gratified with the end result that for forty years and more, the systems have been working flawlessly.

MEP Systems And Innovations

Our highly innovative MEP systems design for hotels spread across Bharat through word of mouth and travelled as far as Doha, Qatar, Dubai and Canada. We designed five hotels in Qatar for the Asian Games in 2010. But closer to my heart are the beautiful systems we designed for palaces across Bharat. Maharajas have converted major parts of their palaces into super deluxe hotels, with our help. This has become a regular source of income for them. Since we had done a dozen hotels for ITC, they invited us to design MEP for Ummed Bhawan Palace, Jodhpur, when Maharaja Gaj Singh accepted their franchise offer. Similarly, Taj Group invited us to design MEP

for their star property Hotel Lake Palace, Udaipur, which is owned by Maharana Arvind Singh Ji Mewar (Sreeji).

My fondest memory is designing for Sreeji his Shiv Niwas Palace, and Fateh Prakash Palace with an exquisite glass museum, Durbar hall, Shikaar Vaadi in Udaipur, a palace in Jaisalmer, a palace in Bikaner and others. I was his state guest for a week several times, carefully analyzing the location of the plant room, chilled water pipe routes, terminal unit locations, piping connections and toilet piping.

Most palaces were built with stonewalls, 300–600 mm thick, with no possibility of drilling through them. Therefore, the logical solution has been exposed piping covered with false walls, crossing into rooms at the bottom of arches and modifying the shape of the arch to hide the piping. All assembly halls have Jharokhas for the queen to sit and watch court proceedings from behind the Jaali. In this way she is not seen but she sees every activity in the assembly halls. Into the Jharokhas went our terminal units to provide air conditioning for the assembly hall without being visible. Terminal units for guest rooms went onto the top shelves of walk-in-closets and grilles on the face of the closets supplied the conditioned air to the rooms. Grills at the bottom of closets took in return air through slotted shelves.

Since creating a service floor was not possible in palaces, all piping was laid exposed on the terrace floor 200 –300 mm above the finished surface to permit drainage of rainwater pipes, which were enclosed in removable waterproof covers, and proper slopes were maintained; supports for piping were placed strategically for the convenience of technical personnel to walk on. The fallout of this labor of love was a dream-come-true for me.

I had always hoped to use my design innovation abilities for a project of national importance. My classmate had done the design for the Sistine Chapel—which has Michelangelo's

legendary ceiling—in Rome. I wanted to design for the Durbar Hall in Rashtrapati Bhawan, where National Awards are presented by His Excellency, the President of India.

The President of India, Dr. Abdul Kalam was the Chief Guest for the IGBC Green Building Congress 2008 in New Delhi, where I, being Chairman of GBC and IGBC, was the host. He got to know about my having brought to Bharat the world's highest award in air conditioning - Distinguished Fellow ASHRAE. He also knew that I had designed the air conditioning for PMO, Vigyan Bhawan, AIIMS, Osho Meditation Hall, Pune, and the Siddhi Vinayak Temple, Mumbai.

The President of India invited me to design the air conditioning for the Darbar Hall, with zero alteration of its interiors. This was my heart's desire and I readily agreed to do it pro-bono, just for the great honor. The Darbar Hall has Jharokhas backed by Jalis like the assembly halls of Mughal kings. My air conditioned air supply at 16 deg.C came from existing Jalis, with terminal units some distance away to achieve pin-drop silence, as we had done for the Osho Meditation Hall, Pune. Return air was drawn from the top part and passed through an enthalpy wheel for precooling outdoor air and returned to the terminal unit. Dr. Kalam wanted CFD analysis and a similar design working; these were complied. I ensured that he ordered the installation before moving out of office and my crowning glory of a long career is still working beautifully.

Energy Conservation Strategies – Passive

Over the last fifteen years, IGBC has perfected several energy conservation strategies – both passive and active. Detailed guidelines are available through IGBC for easy

implementation. Due to the large value of the registered green footprint and consequent high demand, most of these are easily affordable with a small return-on-investment. Energy being the costliest of Pancha Bhootas and still in short supply within Bharat, energy conservation has attracted the greatest attention of both users and suppliers.

Some of the more important passive energy conservation strategies with low cost, and with wider applications across all the climatic zones of Bharat are presented below:

1. Thermal mass to store heat and radiate it to the night sky

Many parts of Bharat have a desert-like climate – hot and dry in the daytime and cool at night. Ancient Bharat had built massive forts all over, to prevent invaders from entering and harming its occupants. Even the Havelis adjacent to the desert areas had massive stone walls to keep out the hot winds and dust. This type of climate in the northern region of Bharat—Rajasthan, Uttar Pradesh, Bihar, Madhya Pradesh, even Gujarat—offer a unique opportunity to store heat in thick external walls. This does not allow heat to penetrate indoors, and radiates it back to the cool night sky.

During my graduate studies at University of Minnesota, my professor advised me to use Fourier analysis to calculate the optimum thickness of walls and roofs for varying diurnal variations in summer. Its findings have been converted into an easy-to-use nomograph for use in different climates. IGBC has gone a step further. With the help of our brilliant academicians, who are gurus to IGBC, detailed guidelines are available for cities where this simple heat swinging can be used to keep interiors cool.

2.Thermal mass for precooling hot air through Indirect Evaporative Cooling

This offers an inexpensive passive energy conservation strategy for offices, which work eight hours only during the day and close down for the night. Our Godrej Business Centre, Hyderabad, uses this indigenous method (designed by Surinder Shah) in the form of the Sheetal Minar. This was inspired by the famous Char Minar in downtown Hyderabad, and has become an iconic architectural feature of GBC. Surinder Bhai calculated the optimum height of the Minar, loosely filled it with the predetermined weight of pebbles and created a bird and weatherproof cap on top of the Minar with the provision to draw in outdoor hot air.

The bottom of Sheetal Minar is connected by ducts to all terminal units in different occupied areas, for fresh air intake. Water is allowed to cascade down the stored pebbles at night, cooling the thermal mass of pebbles. During office hours the water is turned off. The supply air fan at the terminal unit draws in fresh air from the top of the Minar across the cool pebbles, thereby pre-cooling it. This air then mixes with the return air, is cooled and dehumidified across cooling coils, and supplied to the air conditioned areas. This sensible precooling of hot fresh air results in considerable energy savings for the air conditioning system.

This system has been used extensively for providing comfort in mechanically ventilated buildings that do not need air conditioning.

3. Free cooling at night for office buildings

Even buildings with normal wall thickness which have eight hours a day working pattern can take advantage of the large diurnal variation during summer months in the zones of hot,

dry and composite climate. The air conditioning system is run every morning prior to office timings, without any chilling, in ventilation mode. Cool outdoor air is drawn in during the early morning hours to flush out the stored heat in the walls, floors, furniture etc. Thus, when the air conditioning is switched on later in the morning to cool the building further, the subsequent cooling requirement comes down because it does not have to neutralize the stored heat of the night. This energy conservation strategy is used extensively in larger cities and the majority of northern parts of Bharat, such as Delhi, Gurgaon, Faridabad, Noida, Jaipur, Indore, Patna, Bhopal, New Raipur, Ahmedabad, Baroda and others.

Similarly, coastal areas of Mumbai, Chennai and Cochin use large openings facing the sea for cooling during periods when the breeze comes from the sea towards the land.

4. Thermal Insulation of external walls and roofs

- Roof Insulation

For most parts of Bharat, thermal insulation of roofs exposed to overhead sun for long hours, pays rich dividends in terms of keeping solar heat out, leading to a substantial reduction in air conditioning load. Earlier, buildings used expanded polystyrene (Thermocol) slabs of 50–100 mm thickness. Since Thermocol absorbs water, and can cause damage to the waterproofing above the insulation, it could lead to roof collapse. Therefore, the search was on for closed-cell insulation material which would have zero water absorption. We were specifying extruded polystyrene blankets for years, but because they had to be imported, they were considerably more expensive than Thermocol.

IGBC had a major role in the transformation of this market. Seeing the exponentially increasing demand for

Green Buildings, many manufacturers jumped into the fray. Today, extruded polystyrene price is compatible with the price of Thermocol, hence Thermocol is not used for roof insulation anymore.

Further R & D work has been done on extruded polystyrene, which now caters to both thermal insulation and waterproofing. However, it is still subject to damage by ultra-violate radiation. Therefore, the procedure for use of extruded polystyrene includes the following steps:

Selection: Optimum thickness and density of the extruded polystyrene blanket is selected. Most manufacturers have developed software for their products; it is passed on gratis to green consultants, architects and MEP consultants. By and large, the thickness for heavy density extruded polystyrene varies from 10 mm to 40 mm.

The surface of the roof which is generally flat in most parts of Bharat, is finished with a slope that leads to rainwater down-takes. Two or three layers of extruded polystyrene blankets are laid on the roof, with flashing on the parapet walls. The lateral joints (maximum width being 1 meter) are staggered in alternate layers laid in the perpendicular direction. The joints are sealed with a cold-setting compound; this is also supplied by the manufacturer.

To prevent the insulation waterproofing from getting damaged by ultra-violet rays, a thin layer of masonry is applied on top and while still wet, broken glazed tiles are put in a random pattern to provide a reflecting surface to the finished roof. These broken tiles are available free from the manufacturers. Alternatively, high albedo paint can be used.

There are many other local practices in different parts of Bharat like brick bat coba, glass fiber, etc. In some coastal areas where rainfall is heavy, sloping roofs are used with an attic space below. This acts as an excellent barrier for thermal

transmission to the interior spaces. These roofs are covered with slate or clay tiles.

5. Wall insulation

Traditionally, external walls are not insulated, primarily because of lack of availability of a suitable product that can withstand our diurnal variation, rain and dust. Therefore, when the Energy Conservation Building Code (ECBC) specified wall insulation, it was applied on the inside surface of external walls. This defeats the basic purpose since the heat has already penetrated through the walls to the inside surface. The fundamental of thermal insulation is to apply it on the hot side of the external surface, which, for most parts of Bharat, is the outer surface of walls.

6. Cavity walls

Cavity walls of precast concrete panels with sandwiched thermal insulation offer an excellent solution for middle to high-range buildings. Therefore, for more affordable construction, IGBC has developed a widely used solution for the construction of non-load bearing filler (within structural framework of beams and columns) walls by using AAC blocks. These are autoclaved aerated concrete blocks, made from 30 – 40% fly-ash mixed with concrete, aerated, made in moulds or machine cut, autoclaved and supplied. The trapped air provides thermal insulation.

7. AAC blocks

AAC blocks are manufactured by small-scale industry units all over Bharat, to avoid long-distance transportation.

These offer an excellent substitute to traditional clay brick construction, which used clay from the earth fired in kilns, causing pollution and were prone to damage during transporation. In addition, a clay brick is resistant to heat, offering little thermal insulation.

AAC block can be made in any size; the common block size is 250 mm x 150 mm x 150 mm. These are laid out the same way as bricks, using a thin layer of mortar. Generally, both inner and outer surfaces are plastered with mortar and finished with waterproof paint on the outside, and low-VOC plastic emulsion paint on the inside. Conduits can be laid within AAC block using a chase cutter.

The huge demand for AAC blocks, coupled with local manufacturing by small-scale industries, have led to the cost of AAC block being compatible with, and often lower than the cost of traditional bricks (due to transportation). AAC blocks have completely replaced brick wall construction in metros, tier one, two, and three cities and even in towns. Thermally insulated envelopes, providing maximum energy conservation, have become easily affordable.

8. Lighting energy dramatically reduced through Day lighting

There are many applications such as industrial/factory and institutional buildings, government and municipal schools, public libraries, warehouses for dry goods, and low-income residential complexes, where air conditioning is provided only in essential spaces like control rooms, computer rooms, laboratories, main hall, etc. Also, in the hot and dry climate, evaporative cooling without refrigeration, air washer units, mechanical ventilation and even natural ventilation is sufficient to provide some comfort. In most of these

applications, internal lighting becomes the predominant consumer of energy.

We are fortunate that, unlike most parts of the western countries, almost all parts of Bharat have on an average 300 and more days of sunshine. Therefore, IGBC has diligently worked towards harnessing daylight into occupied spaces, without causing glare, and simultaneously minimizing heat ingress to avoid additional air conditioning loads.

The methods used are broadly as follows:

- Wherever possible, the maximum width of the building is 12m with windows on both sides. For most parts of the day, sunlight penetrates up to 6m from the window, thus day-lighting the entire interior space.
- Where the width is greater than 12m, light shelves are provided above the windows with a high single glass window. These allow light to bounce off the ceiling, bringing daylight into another 3-4m of interior space on each side of the window.
- Light tubes of fiber optics are available which take the sunlight from the top of the building and bring it to dark spaces up to 2-3 floors below. These can be bent at specified angles without causing any loss of daylight transmission.
- The Window to Wall Ratio (WWR) specified in the ECBC is a maximum of 40%. Full-height glazed windows are not desirable with our excessive sunshine. These are commonly used in western countries to coax daylight inside the buildings. IGBC goes a step further by reducing WWR to 25% for Green Buildings. Additional credit is given for reducing it further, without sacrificing day-lighting for all occupied interior spaces.

- Special glass with high visible light transmission (VLT) and a low value for minimum heat transmission is used in high-end commercial projects. Special coatings and careful modulation can eliminate glare.
- IGBC has helped in developing low-cost lighting simulation software; this helps the green consultant, MEP consultant and the architect to optimize the size and orientation of windows and the use of a specialized glass can maximize day-lighting throughout the year. The majority of commercial projects registered with IGBC, amounting to more than 1.5 billion sq.ft. built-up area, use lighting simulation software. Findings are discussed with project teams to select and implement those strategies which fit the project's budget.
- Most of the applications have working hours or living hours after sunset. Therefore, artificial lighting has to be provided. For commercial applications, this is lux-controlled with occupancy override, and provided with electronic dimmers. Therefore, lighting comes on to maintain the desired lux level in occupied areas only after daylight cannot meet the requirement of the space. Therefore, visual comfort level of the occupants is optimally maintained throughout the day and night.

9. IT Tools

Information technology advances have provided many important tools to the construction industry.

Revit modeling allows three-dimensional drawings incorporating the structure and 18 to20 layers of MEP services. The clash analysis of these Revit drawings eliminates any correction required at site, so that construction can proceed smoothly without any reinstallation.

BIM modeling gives five-dimensional analysis including the time and cost of construction. This is extensively used for all large and mega projects.

Building Envelope Optimization

One of the most useful IT applications for the construction of Green Buildings is the development of relatively inexpensive software for the optimization of building envelope design.

The owner or developer, architect and consultants have to jointly guesstimate the building's operating parameters throughout the year. These parameters are for building occupancies with fixed staff and visitors, their operating hours, operating days (excluding holidays, weekends), internal heat generating equipment such as servers, IT service stations, computers, plotters, printers, photocopying machines, etc. With the reasonable accuracy of these parameters, detailed operating characteristics (power requirement) for air conditioning systems, mechanical ventilation, internal lighting, pumps operating data, and elevators etc. are incorporated. The software can predict daily, monthly and annual energy consumption within + 5% of actual values.

This is useful in predicting the reduction in annual energy consumption by varying different components of the building envelope. These variations are: orientation, extent of glazing, use of glass with varying VLT and U values, and the thermal insulation of walls and roofs. Associated capital and operating costs for each combination is computed and a menu is available to the project team to make a capital cost or lifecycle cost-based judgment for each option. The project budget and financial viability dictates which variation of parameters is to be implemented in the envelope design for optimum results.

All the above passive energy conservation strategies, involve one-time small capital expenditure with very short

return on investment (less than one year) and no operating expenditure.

Energy Conservation Strategies – Active

The following active energy conservation strategies involve varying additional capital costs, but the operational savings in energy consumption result in a payback period of 1-3 years, except the solar PV power generation, which currently has a return on investment of 5-7 years. It is gradually coming down and may level out in the near future.

1. High efficiency air conditioning system components

- Central Water Cooled Air Conditioning System

Energy guzzling reciprocating chilling machines died a natural death in the 80s and 90s. These have been replaced with centrifugal chilling machines of 200 TR-5000 TR capacity for larger projects or by screw chilling machines of 50 TR–450 TR capacities. Smaller capacity rotary compressors are available for unitary air conditioning systems. Recently, magnetic levitation driven compressors have been introduced; these have no friction since there are no bearings.

- Water Chilling Machines

Most of the chilling machines (except magnetic compressors) have a full load Coefficient of Performance (COP) of 6.0 – 6.5. This results in power consumption of IKW/TR of 0.65 at full load for water-cooled systems. However, most commercial buildings perform at full load for less than 10% of the time during the year. Therefore, a more valid annual energy consumption measure is the integrated part load value (IPLV) of the chilling machine. Actual observation of

recorded data over the years indicates that the largest number of operating hours of chilling machines are between 50 – 75% full load capacity. Therefore, IPLV for our country is estimated on a statistical average.

It may be kept in mind that chilling machines are not operated below 40% of full load capacity to avoid surging and flooding of compressors. Instead, these are automatically switched off; permitting chilled water supply temperature to rise till the encountered load is 40% or more. Therefore, a clever solution that has been used for decades is of providing three chilling machines of 40% full load capacity, working in a synchronized mode. The Building Automation System (BAS) automatically sequences these for equal number of run-hours for uniform wear and tear, and for preventive maintenance.

Use of IPLV results in COP in excess of 10 and IKW/TR of less than 0.4, thus making it highly energy efficient.

- Pumps

Generally centrifugal pumps were used, mounted on a common base with a squirrel-cage induction motor, leading to coupling losses and bearing losses. These also occupied plant-room floor space with the necessity of elbows in piping, both at the suction and the discharge from the pump. In the last twenty years, on-line rotary pumps with 15-20 HP motors have replaced these floor-mounted centrifugal pumps, resulting in much higher pump efficiency.

- Fans

Traditionally, backward inclined blades (for higher static pressure) have been used in terminal units and also for mechanical ventilation systems. These are coupled with a squirrel cage induction motor, generally mounted on a common base, leading to coupling and bearing losses. These are being replaced by axial flow fans, with motors directly

mounted online, and acoustic silencers are provided to absorb higher sound levels. These substantially increase fan and motor efficiency.

- Cooling Towers

The measure of cooling tower efficiency is the approach of cooled water to ambient wet bulb temperature for the fixed specified range. Traditionally the approach of 4 deg.C (7 deg.F), with a range of 6 deg.C (10 deg.F) has been accepted. Bharat has taken the lead in R & D for cooling towers and has produced the world's highest efficiency cooling towers with 1 deg.C (2deg.F) approach, without compromising the 6 deg.F (10 deg.F) range. These are exported all over the world from Bharat, an instance of reverse technology transfer.

2. Variable Frequency Drive (VFD) for All Motors

We had been specifying imported variable frequency drive (VFD) for fan motors in high end hotel and hospital projects. These were expensive. Since the projects had a considerable amount of foreign exchange, they could avail of the exemption of customs duty by importing against the EPCG (Expert Promotion of Capital Goods) license granted by the Customs Authority. Coupled with no excise duty (due to no local manufacture), these were affordable for hospitality and healthcare projects.

Then in 1993–94, we were awarded Bharat's largest and most prestigious project 'Bharat Diamond Bourse' (BDB) at BKC, Mumbai. In this project 100% of the diamonds processed on the premises are exported. Hence there are no duties or taxes. The project was mega-scale, and with our total familiarity with the finest products from Europe and USA, we were able to invite leading global manufacturers

to set up a base in Bharat. Several thousand VFDs were required, and Danfoss set up their office and eventually started manufacturing in Bharat. This was the turning point for the use of VFD's, because when they were manufactured locally, the price of VFD was low enough to pay the cost back through energy savings, in less than one year.

Power consumption by a motor varies in the cube of motor speed. Therefore, 50% speed implies power consumption of only 12%, a phenomenal saving in its operating cost, all from energy conservation. Therefore, the majority of IGBC certified Green Buildings use VFDs for practically all three-phase motors above 5 HP capacities.

- **Variable Flow Pumps**

The BDB project in Mumbai gave us the opportunity of introducing variable flow pumping. I had extensively used Bell and Gosette(B&G) pumps during my ten years of consultancy, with my advisor at Minnesota. These have a Fix and Forget capability, demonstrated by working nonstop for years and years. For the BDB project, we imported more than one hundred pumps with Danfoss VFD, mounted at B & G factory, for BDB. The phenomenal energy savings were talked about extensively. Twenty years later, variable flow pumps have become industry standard. The requirements of VFDs runs into hundreds of thousands and prices have come down phenomenally. Today there are large numbers of manufacturers of VFDs in all regions of Bharat.

- **Ventilation Fans with VFD**

Mechanical ventilation fans generally run non-stop and consume considerable energy. Green Buildings specify control parameters like CO level in parking lots, CO2 level

in occupied spaces, VOC level in air conditioned spaces for exhaust fan operation. VFDs automatically vary the speed of ventilation fans as per control parameters, saving power in the cube of percentage speed reduction.

Similarly, Demand Control Ventilation is used in air conditioned spaces, by motorized operation of fresh air dampers at terminal units, in response to CO2 levels in the return air stream. This implies that the tempered fresh air quantity at the terminal unit mixing box corresponds to the occupancy in air conditioned space, saving energy required for the treating and supplying of tempered fresh air.

- **Cooling Tower Fans with VFD**

In large air conditioning systems like BDB Mumbai, the number of cooling towers and their fans consume hundreds of kilowatts of power. Considerable savings in cooling tower fan energy consumption is achieved by varying its speed from zero to a 100%, in response to ambient wet bulb temperature, with zero (no fan) at low ambient wet bulb.

- **Variable Speed Refrigeration Compressors**

Compressors of the chilling machines consume nearly half the energy consumed by air conditioning system. Varying the speed of the refrigerating compressor had been a challenge for most manufacturers like Carrier UTC, Trane Ingersoll Rand, York Johnson Control and Clima Veneta Mitsubishi. The problem was to ensure oil return during the low speed of the compressor to avoid liquid slugging of the compressor. It was finally solved in the early part of this century. Now most chilling unit compressor manufacturers offer variable speed compressors, controlled by chilled water return temperature. The resulting savings in energy consumption are of a higher magnitude.

3. Heat Pump and Reverse Cycle Heating

While I was working at Carrier RDC, we assembled the first split air conditioning unit, which eliminated many of the ills associated with room (window) air conditioning (RAC) units. The slogan used for promoting the split unit was 'Divide and Cool', derived from the British policy of Divide and Rule.

Major parts of northern Bharat, including my hometown Delhi, and many southern states in the USA, have long hot summers and very brief winters. We debated that if room air conditioning units could be modified so that the operation of the evaporator and condenser could be interchanged by reversing the flow of refrigerant, hot air from the condenser could heat the room and cold air from the evaporator could be discharged to the cool outdoors.

The idea of Reverse Cycle Heating, that is, air-to-air heat pump was perfected by the RDC team. Internal piping was modified so that on the command of the "heat" switch, hot vapor at high pressure goes to the evaporator, which acts as condenser and discharges hot air, that is then supplied to the conditioned space. The high pressure, moderate temperature liquid is directed through an expansion valve and the low-pressure liquid goes to the condenser, which acts as the evaporator. Thus, winter heating is achieved using much less energy from the compressor, than by electric resistance heating elements, which add fire to the risk.

One of the luxuries I permitted myself to bring home with me was a Carrier 1½ TR room air conditioning unit, equipped with a heat switch for winter heating.

Since then, Carrier concentrated on central air conditioning systems, but Japanese manufacturers developed split air conditioning units, multi splits, VRV, VRVs with inverters for maximum comfort at lowest energy consumption

by unitary air conditioning systems. European manufacturers have similarly perfected heat pumps with indigenous R & D work. We now have air to water, water to water, and ground source heat pumps in all sizes and capacities. The biggest user of heat pumps is Australia.

4. Evaporative Cooling

The art of evaporative cooling for comfort, in Bharat's hot, dry and dusty climate, has been used since the times of Mughal kings, over 500 years ago. Summer winds in the northern parts of Bharat are predominantly westerly. A fibrous curtain woven with a sweet-smelling weed called Khas used to be hung on the larger openings on the west side. A perforated copper pipe was placed at the head of the curtain. Water stored in a tank at a higher level was piped to the copper pipe on a required basis. As water cascaded down the curtain, the outdoor hot and dry breeze was induced across the curtain by a smaller high opening on the opposite wall, and (lee ward side) it cooled down by the evaporation of the falling water on the air stream. Indoor air became cool and fragrant. When water was not available in an overhead tank, a laborer sprinkled it from a goat-skin bag called Mashak.

With the advent of pumps locally manufactured and available all across Bharat, the once-through system has been replaced by re-circulation of water. The falling water also cools down and improves the efficiency of the system. An axial flow fan is added for the supply of cool air to the space. These evaporative cooling units have been extremely popular all across northern Bharat, because of their low price and low operating costs.

The science of evaporative cooling has been developed by Professor John Watts of Texas University, Houston (USA). It gives the optimum size of elements, performance

parameters of the system and a comprehensive analysis. It uses excelsior (coated paper) for the cooling medium, which was earlier imported from USA by our manufacturers. It is now available from Indian manufacturers at a moderate cost. Large cooling systems have been installed in many north Indian cities and towns. These are very effective for the hot and dry summer months of March to June. But these are not useful during monsoon months of July and August, since outdoor air is already laden with excessive moisture. Again these have limited use during September to November, when the outside air is warm and humid.

Our engineers and designers have found ingenious solutions to overcome the limitations of evaporative cooling during the monsoon season.

Hybrid Cooling-cum-Air conditioning

Terminal units of a central air conditioning unit are modified by adding an air washer coil and eliminator. Thus, the configuration becomes a mixing box (RA + TFA), pre-filter, bag filter, air washer coil with water spray upstream, eliminator, cooling coil, reheat coil (if required for RH control) and centrifugal fan with motor. Water is sprayed upstream on the air washer coil to provide the cooling of mixed return air and tempered fresh air by evaporative cooling. Water is circulated again and the excessive water riding with the cool air is removed at the eliminator. It works beautifully for the hot and dry summer months, when the cooling coil remains inactive so that chilling system energy consumption remains very low.

During the monsoon months, the air washer coil gets deactivated and the cooling coil is supplied with chilled water at 7°C, resulting in cold and dehumidified air. The mixing box, filter section, and fan section are common to both

operations—evaporative cooling and chilled water system. Thus, considerable energy is saved by using hybrid systems where summers are hot and dry, and the monsoon months are hot and humid, which is the case in many parts of Bharat.

Direct-Indirect Evaporative Cooling

Indian entrepreneurs have developed direct-indirect evaporative cooling systems. The evaporative cooling system is used to cool water, not air. This cool water is further chilled and passed through a cooling coil to give double the advantage. These are very effective when the monsoon dry bulb temperature remains in the twenties, so that evaporative cool water can still provide comfort indoors. These are extensively used in southern parts of Bharat and are also exported to California, USA.

5. Lighting

Lighting for occupied spaces has gone through revolutionary changes in the last forty years. The once common GLS bulbs (Tungsten-Filament) have become history. First these were replaced by Florescent Bulbs in 2-6 ft. lengths, which were harmful to the environment because they contained mercury. These were largely replaced by compact florescent bulbs (CFLs) in 6-24 Watts capacity. Ultimately, in the last twenty years, LED lamps for solid-state lighting are replacing all the above lamps. The greatest USP of LED lighting is fractional energy consumption and long life of upto 50,000 hour (6 years). A large variety of colored LEDs are available for rendering drama to occupied spaces.

Power consumption for illuminating interior occupied spaces up to 300 Lux, has changed from 2Watt/sqft to

0.3 Watt/sqft—that is down to 15%. In residential and institutional buildings, where air conditioning is used marginally, illumination energy is 40–50% of the total energy. Therefore, LED lighting is the best solution. Thanks to Energy Efficiency Services Limited (EESL), Bharat has become the world's largest market for LED bulbs and prices have gone through great reductions, making LED bulbs affordable for the common person. Almost all new Green Buildings use LED lamps for all internal illumination requirements, thereby saving huge amounts of energy for the country.

6. Elevators, Escalators, Travellators

The Indian market for elevators had been dominated by the OTIS Elevator Company, the inventor of elevators. Thysson Krup offered a large basket of industrial products, which included Elevators, Escalators and Travellators; these have had a very small share of the market.

When the mega project of BDB Mumbai came to us, the managing committee wanted to explore the use of the world's finest, since import against EPCG license implied no customs duty and no excise duty. The order was for 80 elevators for a single project, large enough for any major manufacturer to enter Bharat and compete with the well-established OTIS.

We presented our designs to the Dubai representative of Mitsubishi Elevators of Japan. The General Manager of Mitsubishi from Tokyo and the engineering owner of a Dubai based company flew into Mumbai the very next day. They met the managing committee of BDB along with us, to explain how Mitsubishi Elevators arrived at the world's no. 1 position, retaining it for years. The features were music to members of the managing committee: fix and forget;

zero repair/maintenance calls per year; ride so smooth that a coin kept vertically does not fall; and leveling with the floor within + 2mm. They are equipped with an auto rescue device (ARD) standard feature so that in case of a power failure, the elevators come down to the floor below and cabin doors open. Any earthquake tremor kicks the ARD to bring elevators to the next level floor and elevators cannot be started till all tremors have died. All elevators can be used as firemen's elevators; all the components of these elevators including brackets and ropes are made in Japan; and there are many other important features.

The problem of huge cost implications seemed insurmountable and the managing committee wanted us to explore further with Mitsubishi. We explained to them the enormous potential in Bharat, starting with our own 200 hospitality and healthcare projects, provided the price was competitive.

Japanese industries have an amazing policy. When one of the large industries wants to enter a new country, all of them pitch in with their own resources to support the concerned industry—whether or not it is directly related to their own products—all in the national interest of promoting Japan. And the most amazing thing happened. Mitsubishi Elevators, the world's leader that was normally 2–3 times more expensive than the local companies, matched the price of OTIS Elevators with a two-year extended warranty (against OTIS one year) included as part of their quote.

The offer of Mitsubishi stunned the managing committee and the decision to award them Bharat's biggest elevator project was unanimous and instantaneous. It also was a wakeup call for OTIS that their monopoly had ended and henceforth OTIS would be more malleable. The immediate fall-out was that for another of our projects a few years later, OTIS offered their latest technology replacing Thyristor

drives by Variable Voltage Variable Frequency (VVVF) drives at highly competitive prices. This was followed by machine-room-less elevators and the regenerative elevators, where during the return trip, power is generated by the elevator through the help of gravity and fed back to the supply grid. For a large number of elevators (generally more than 10 Nos.) in commercial building projects, the extra cost of regenerative elevators, gets paid back within five years, making it an attractive ROI.

The current energy conservation feature of elevators for a Green Building is the use of VVVF Technology. Thanks to the patronage of IGBC, VVVF elevators are now the industry standard for commercial and industrial applications, as well as for large residential complexes. The energy savings over the old Thyristor drives results in ROI of one year; this is invariably the choice of developers and builders.

7. Integrated Building Management System (IBMS)

My first exposure to Building Automation System (BAS) was in 1960. I worked as a mechanical engineer with the world's no. 1 medical architects Ellerbe and Associates, who had designed Mayo Memorial, USA; Jeddah Hospital, Shanghai Hospital etc., St Paul and the twin city of Minneapolis. They had a patented design for remote control and monitoring of Indoor Conditions of Temperature, RH, Pressure and VOC levels in Operation Theaters; Radiology - CT scan, X-Ray, MRI, Intensive Coronary Care Units (ICCU) and the Intensive Care Units (ICU). This enabled the operator to physically make the changes in the system's operation to bring the above-mentioned critical parameters within the desired range.

Later I worked part time at the University of Minnesota's Physical Plant Services, and was responsible for the operation

and maintenance of services systems at the university campus. They had also undertaken the operation and maintenance of the district cooling system serving downtown Minneapolis, comprising high-end department stores, multi-storied offices, hotels, and recreation facilities like the Guthrie Theater. It was an eye-opener to see how from a central location, a single operator in-charge was able to monitor the Temperature and RH in occupied spaces in scores of tall buildings. Controllers from each space were hard-wired to a central indicating lighting panel, giving the on/off status and the values of inside temperature and RH. Even audible alarms and flashing lights, and indicating lamps were provided to alert the operator when any parameter went outside of the specified range. Since computers and IT software had not arrived yet, any corrective action had to be manually activated.

A lifetime opportunity in consultancy came to me when my Advisor asked me to work with him on the world's most talked of project of Apollo's Mission to the Moon. There were 60 odd buildings at the Space Command Centre, where various activities were going on at super speed to keep the date of launch as decided by the then President of America, John F Kennedy. We had designed air conditioning systems for specified indoor conditions for each building, including the Command Control Center. It was required to monitor and control these parameters from the operator's desk. NASA had sophisticated computers, therefore, it was a matter of software programming; this was similar to the research work done for my Ph.D and my work at Carrier RDC.

I had my first full scale experience of designing a Building Automation System (BAS) for a sophisticated district cooling system. Neil Armstrong's successful landing on the moon and his immortal words: 'That's one small step for a man, one giant leap for mankind', enhanced my credibility as a consulting engineer by great magnitude, and consequently,

the managing committee of Bharat Diamond Bourse, Mumbai, gladly gave me the most sophisticated assignment to design—the Integrated Building Management System (IBMS) for BDB. This comprised the design and integration of the following:

- Building Automation System (BAS)
- Smoke and Fire Alarm and Suppression
- Electronic Security of the entire premises
- Electronic Security for Occupants and Visitors to BDB

The cost of IBMS was estimated by us to be Rs. 1 Billion (100 Crore). It was enough to get the world's best names to set up a base in Bharat and try to win. The future potential was unlimited. Upon my request, the managing committee sent me and my colleagues to study security systems in New York, and in Antwerp (Belgium) where the managing committee had large offices.

Since the world was my market, I designed the finest Security System of my career, including the Tunnel of Truth for every car to pass through, where even small traces of explosives could be detected. All occupants and visitors had to walk through this so that any metal and traces of explosives could be detected. There was also an inaccessible office (even to BDB Management Committee) for the security commander, who could come and go unseen. There was also a break-glass control meant only for the security commander to liquidate all security locks for access in case of a terrorist attack or confirmed smoke in the building, to be able to hold the terrorist in the stairwell if he tried to escape, and a system to evacuate the diamond vault if any movement was observed after the last authorized personnel had left and the vault was locked.

The managing committee was hesitant to assign security work to a foreign group like Israel, so we found an Indian Company, Memco in Dubai. They were responsible for the Electronic and Manual Security of Sheikh Zayeed, one of the richest and most vulnerable rulers in the Middle East. The contract was for Rs. 600 million (60 crores) and was awarded to Memco. Unfortunately, the management committee lost the election, members with limited vision took over, and the entire project got stalled.

The next opportunity came for designing IBMS for the then Finance Minister of India – Dr. Manmohan Singh. He wished to have in New Delhi, Industrial Finance Corporation of India (IFCI) on the same lines as the International Finance Corporation (IFC) in Washington DC. With NASA experience and design for BDB, my credentials were impeccable. Architect Raja Aederi, a student of Frank Lloyd Wright, and I teamed up to deliver in 12 months, a 20 storied ultra-modern building of steel construction, using the slip form technique. Bharat's best IBMS system was installed by Johnson Controls at an exorbitant 15% of the cost of the whole project.

Besides assured electronic security for the premises, occupants and visitors, an idiot-proof smoke-alarm and systematic evacuation in case of fire, it permits automatic operation of all MEP systems. The HVAC systems are not only monitored but also controlled from a control command room, to ensure that every component of the system operates at maximum efficiency, so that the last Watt-HR of energy is conserved. With the import of IBMS components becoming duty free, the system cost has come down to about 1% of the project cost. Therefore, most Green Buildings–commercial, industrial, institutional and residential complexes with the exception of individual residences, use it.

A program is being developed by IGBC to link the IBMS of willing clients of IGBC certified Green Buildings, to a central control point. This would verify that the building is performing as designed, and would warn the client of any deficiencies.

8. Solar PV Green Power Generation

This is not an energy conservation strategy but an operating cost-saving methodology. IGBC gives additional credit under the energy head, for meeting part of energy requirement of a project through solar PV Green Power generation, preferably on-site, or else off-site.

With the Government of India's ambitious program of meeting 20% of Bharat's energy needs, including future development, through solar power generation by 2030, it has given great impetus to the vendors.

In metros, solar rooftop units are gaining ground since additional power, over and above the building's needs, is fed back to the city grid and net metering is provided. The user pays only for the balance of grid power consumed. Delhi Metro is an outstanding example where 50 MW is generated through rooftop solar PV on roofs of their overhead Metro stations, and on top of associated facilities like the plant room, arrival hall etc., for underground Metro stations. In fact, Delhi Metro has evolved a Win-Win method of giving a structurally reinforced roof surface to service provider, who installs his own solar PV system and assures continuous power supply to the Metro station at a fixed tariff of less than Rs.5/kWh, almost half of the commercial tariff by city supply authorities. This is a Win-Win situation with no capital cost and large savings in operational cost.

This has been possible because solar PV generation costs have been constantly decreasing. Today's capital cost of solar

PV generation is almost 1/5 of the capital cost ten years ago, all because of the humongous demand and breakthrough in technology.

The ingenious projects of 'Shoonya' for small residences in Noida, and for offices in Bangalore are among iconic projects for energy conservation. Zero power is drawn from the city power supply grid; instead, solar energy meets 100% of the power needs.

Summing Up

The energy conservation strategies listed here may be of interest to designers and users to take advice from their MEP consultants and green consultants. The first step is to apply the maximum number of strategies mentioned above. If all passive majorities of active strategies 1 to 3, 5 and 6 are used, the resulting energy requirement comes down to 25% of conventional buildings; a major part of this can be met through solar PV generation, resulting in a spectacular minimum operating cost. The capital cost of the above passive and active strategies, except solar PV, gives ROI of 3 years, which is a financially attractive proposal. The thumb-rule for Green Building energy requirement drops down to 4 Watts/sq.ft. of built-up area in comparison to 12 Watt/sq.ft. earlier.

CHAPTER SEVEN

Water Conservation: Neer - Saagar

Jal bachao, kal bachao

—IGBC war cry on Water Conservation

Water, water everywhere, not a drop to drink

—*Samuel Taylor Coleridge*

From its arrival on earth to the vast areas it traverses
Before emptying into the sea, water holds all the
Knowledge and experience it has acquired.
As phenomenal as it may seem,
water carries its whole history,
just as we carry ours.
It carries secrets too
Water has a memory
and carries within
our thoughts and prayers.
As you yourself are water

No matter where you are,
your prayers will be carried
to the rest of the world
The Secret Life of Water

—Masaru Emoto

Our body can go on for a month without food but will shut down without water in less than a week. And yet, we are the only species disregarding the laws of Nature and mercilessly destroying the fresh water reserves on our planet. Water scarcity will drive nations on to water wars and it has been predicted that the Third World War will be about owning natural water resources.

In the twentieth century, human population increased 3 times, but domestic water consumption went up 6 times. Every fifteen seconds a child dies somewhere in the developing world from water-borne diseases; for how long will we not learn? We have the specter of dramatic increase in our population in the coming years, which could easily lead to catastrophe of unimaginable proportions, unless the remedial measures are implemented on war footing.

'Water, Water Everywhere, Not A Drop To Drink'

I recall the above words from my high school during the late 40s, and how I was seized with the desperation of the Ancient Mariner, drifting all alone in the vast ocean. I could never imagine then, that two-third of a century later and within my lifetime, all life forms on our beautiful planet would be threatened with the same plight.

The paradox is that to an alien from outer space, earth, with more than seventy percent of its surface covered with

oceans, would seem to have abundant water. In reality, only 2½ of all water on earth is fresh water, and less than 1% only is accessible for direct human use. This is found in rivers, lakes, reservoirs and at shallow depth, regularly renewed by rain, mist and snow, and therefore available on a sustainable basis.

India is blessed with the Himalayas, where evaporation from oceans condenses and comes down as snowfall, and many of our rivers originate, travelling across the continent, constantly replenishing our fresh water reserves. The monsoon arrives every year, replenishing all our water bodies and enriching the land.

Industrial pollution came to Bharat a little more than 50 years ago. It came to Bharat from Western shores, and changed our way of life forever. We took to the chemicals and plastics with great eagerness to provide comfort at any cost, totally ignoring the checks and balances imposed on these by the western world.

5000 years of civilized way of life in Bharat has gotten destroyed in just 50 years, resulting in heavily polluted rivers from raw chemical effluents. Our landscape is dotted with plastic in the remotest of villages. Even Mount Kailash, the Abode of Shiva, is covered with tons and tons of plastic waste. Ganga Ma has become a stinking canal from waste matter of tanneries and untreated effluents from chemical manufacturing units upstream.

Consequently, today Bharat ranks amongst the most water-starved nations of the world. This has been the result of gross over-consumption and wanton disregard of our domestic water resources. Alarm bells are tolling, warning us of the impending Maha-Pralay—a manifestation of the Kaliyug.

But All Is Not Lost Yet: Low Hanging Fruits

But all is not lost yet, for here are some of the low hanging fruits, for which intensive efforts are on, to ensure a greener tomorrow for generations to come:

Let us revitalize our rivers, Sarovars and lakes.

1. Revitalize rivers

For the first time since Independence, the Government of India has created a special ministry. It has started work in right earnest to restore Ganga. It is the mystery of Nature that if only we totally stop polluting the flowing rivers, they will revitalize themselves.

2. Restore Sarovars and lakes

The good news is that there are many unsung heroes in Bharat, who have developed highly innovative solutions to restore our stagnant lakes and water bodies. The underlying principle is to provide certain catalysts that activate bacteria in the hyacinth and moss, and use sunlight to coagulate all suspended particles, so that they settle down leaving behind pristine clear water. These catalysts have been highly successful in Bangalore, Mysore, Udaipur and Jodhpur.

3. Harvest rainwater

Chennai has made a complete turnaround in ten years from a water-starved metropolis, to a green city with abundant water resources. This has been achieved by mandating rainwater harvesting for one and all. Strict enforcement by Municipality in Chennai can be a role model for our 7000 odd municipalities spread across Bharat.

The good news is that if we could learn to harvest all the rain that falls on our land throughout the year, Bharat could become water-sufficient, and all the threats for survival of future generations would disappear.

4. *S*et up sewage treatment plants

NBC 2016, recommends that every public building and residential complex should install and operate localized sewage treatment plant, and recirculate treated water for toilet flushing, gardening, horticulture and for air conditioning makeup water, if required.

Singapore is the first country in the world to treat 100% sewage and wastewater to WHO level for drinking purposes and sell as NE Water. In India, Bangalore is the first metro to follow suit and has already reached a level where 25% of city sewage is recycled as water for domestic consumption. Delhi Jal Board plans to emulate the Singapore model and treat all of Delhi's waste water to potable water by 2022.

- **Root zone treatment**: Sewage treatment has been practiced in Bharat for centuries. Our sages living in the Himalayas, and in other far-off places, used to let their bio-waste pass through small streams surrounded by special plants. These plants absorbed all human waste and let only clean water get into the main stream. We perfected this Root Zone Treatment System in 2003 for IGBC Headquarter Building in Hyderabad, to earn for Bharat the world's highest green rating. The system is now widely used in development of Green Infrastructure.
- **Parallel treated water mains**: Already, in the mixed-use land developments on 150–500 acres while planning for IGBC Green Cities (New) Rating, the laying of

two Water Mains, one for domestic water supply and other for sewage treated water supply, is required. The latter gets charged at a much lower tariff. The newly announced 100 Green Smart Cities would do well to adopt the same.

- **The Green Building Movement** also emphasizes the need for adopting native plants, flora and fauna, to minimize water requirements for landscaping. Drip irrigation is encouraged as against use of sprinklers, so that water goes straight to the roots, resulting in better growth with use of only a fraction of treated water supply.

5. Municipal water supply

1. **NBC 2016 Norms**: The current municipal water supply as per NBC 2016 is specified as 135 liters per capita per day (LPCD). This, compared with 100 to 150 GPCD, or 400 to 600 LPCD, in the western countries, will fully address the problem of our depleting freshwater reserves. It will also imply the necessary use of STP treated water for toilet flushing and for horticulture, where fresh domestic water is not permitted.
2. **Low tariff for domestic water supply**: We urgently need to increase the cost of Municipal Water supply, to encourage conservation of water. Cost per KL in different metros of the world ranges from Rs.10 in Bangalore to Rs.500 in Copenhagen.

6. No plastic bottles

One of the curses of modern lifestyle is potable water in plastic bottles. Published data indicates that in 2004, nearly

2 billion bottles of water were used; the number would be far greater today and growing. The tragedy is that at least half of these plastic bottles eventually end up on our beaches, in our rivers, in the oceans and on land, leaching chemicals into underground water reserves.

Thankfully, thin walled, lightweight glass bottles of pre-plastic bottle times have made a comeback in the hospitality industry and will eventually move into the mainstream. Other options are also being tested so that plastic bottles are used less and less.

7. Low flow fixtures

In recent years our water consumption, especially in metros, have gone absurdly high.

Standard Consumption: Water consumption, especially in cities and metros, can be estimated from the following : A standard bathtub consumes 200 L; Rain shower 100 L; Indian WC with Shanks O/H cistern 20 L; and Urinal with pre and post flush, consumes 4 L.

Reviving our tradition of being a bucket-bath nation, some plumbing fixtures have been remodeled to low-flow. Bathtubs are now confined to high-end hotels, health clubs/ spas mainly, shower heads with nozzle consumes only 5L ; WCs come with dual flush using 4L and 2 L; and urinals are water-less, requiring no water at all.

8. Certification and Validation

IAPMO, IPA and IGBC are certifying performance of indigenously manufactured fixtures. The prices of low-flow fixtures are leveling off as the demand is increasing.

9. Green Buildings

Buildings account for 30% of all fresh water consumed and 40% of all waste generated by us. Green Buildings have showcased a dramatic reduction, down to less than 1/3rd water consumption with only 45 LPCD water supplies, laying maximum emphasis on rainwater harvesting and total recycling of wastewater, leading to zero discharge of water from Green Buildings.

IGBC Journey On The Path Of Green

Our journey in IGBC began with the highest platinum rating for our CHQ in Hyderabad, with built-up area of less than 20,000 sq.ft. Today, we stand as world number 2 with 5.7 B sq.ft. These Green Buildings will save Bharat 250 million KL, or 250 billion liters, of fresh water every year. Our aspiration is that in coming years Bharat will be the World Leader with a cumulative footprint of 10 B sq.ft.

In early 50s, we woke up to the brilliant slogan of "Hum Do, Hamare Do", and it did put a pause on our exponentially growing population at that time. Unfortunately, the coercion imposed to implement it during Emergency became counterproductive, otherwise Bharat today would have been a vastly prosperous country. Recently the slogan "*Abki Baar, Modi Sarkar*" gave us a majority government at the Centre after three decades of coalition governments. Let us take to every home in Bharat, the IGBC War Cry: "*Jal Bachao, Kal Bachao.*"

Chapter Eight

Specialized Applications

Problems cannot be solved at the same level of awareness that created them

—Albert Einstein

Waste not the smallest thing created, for grains of sand make mountains and atoms - infinity

—E Knight

What is the use of a house if you don't have a decent planet to put it on

—Henry David Thoreau

When one tugs at a single thing in Nature, he finds it attached to the rest of the world

—John Muir

About IGBC

The central administration of IGBC is headquartered in the Sohrabji Godrej Business Centre in Hyderabad. It is one of the more visible verticals of CII operation. It follows the charter of CII to the last detail. Thus, IGBC operates as a non-profit organization.

We have less than 100 members of the IGBC family at CHQ. A large number of our family members are very young – in their thirties, even twenties. CII norms of salaries are modest but the fringe benefits like HRA, DA, travel allowances, medical insurance etc. are substantial. After the probation period, employment gets confirmed. With the high prestige associated in industries for CII employees, employment tends to be a destination, not a transit position.

It is a tribute to the benevolent and visionary leadership of S Raghupathy, who as head of the IGBC family (Executive Director) from inception of IGBC, kept our young highly committed and extensively well-trained family members together. This is despite the substantially higher financial short-term gains from western P&L and performance-oriented council wanting to extend its presence in Bharat. For his exemplary performance S Raghupathy moved to CII HQ in Delhi as Deputy Director General, responsible for many other verticals of CII. We are fortunate that he is succeeded by the equally charismatic and dedicated leader, Venkat Giri, as Head of IGBC family.

Since inception, IGBC's self-effacing Deputy Executive Director is S. Srinivas. Srini is the sole repository of all technical knowledge of IGBC. He has personally trained almost every member of the IGBC family at our headquarters in Hyderabad, and today IGBC has a group of young brilliant minds driving the content of technical growth of IGBC. Most notable are M. Anand, Karthikeyan, Ritabrata Sen,

Praveen Soma, Navin Akhina, Pallavi, Rekha and others. Outside Hyderabad, we have Shivraj Dhaka, Punit Agarwal, Himanshu, Animesh and many others.

Matters concerning the Green Building Congress, EB Meetings, local executives to assist Chapter Chairman are all handled by our Director M Raghu, veteran of CII and IGBC.

IGBC Rating Guidelines

Unlike developed countries, IGBC has evolved and perfected a highly democratic approach for development of 24 IGBC ratings to date, each one suited exclusively for a specialized application of the built environment – Buildings and Infrastructure.

1. IGBC Green Cities (New)

Over the years, IGBC ratings for Green SEZs became redundant as the Central Government Policy replaced SEZs (Special Economic Zones – for Export only) to mixed-use land development and industrial parks. Similarly, IGBC green townships of 40 -100 acres have become unviable and developers/builders have consolidated the land into mini-cities of 400 – 500 acres and larger. IGBC green townships rating has been expanded into "IGBC Green New Cities".

Some years ago, the Government of India announced the new initiative of Industrial Corridors between Delhi and Mumbai (DMIC), Kolkata and Delhi, Mumbai and Bangalore and several other metros. The objective is to encourage freight-trains at express speed between metros and tier two and three cities. This will deliver industrial goods to all parts of Bharat by non-polluting power-driven freight-trains, rather than by highly polluting diesel-powered

trucks, requiring several days of driving over long distances. The land for these Industrial Corridors has to be given by each of the State Governments, through which the freight corridor would pass. Substantial progress has been made in the last few years only on DMIC - The Delhi-Mumbai Industrial Corridor. The primary reason is that the States en-route belong to the party with the majority Government at the Centre. Another factor is the dynamic IAS officer – Mr. Alkesh Sharma, CMD DMIC, who has worked diligently for the Corridor to become a reality.

DMIC - CMD has patronized "IGBC Green Cities (New) rating" for all new cities coming up along the Corridor. These will ensure minimum relocation of the existing rural population to urban centers in search of employment.

Amongst the most brilliant examples of green-field New City is Dholera in Gujarat, with an area of 49,000 acres - considered to be the world's largest Green City. The Green infrastructural construction for Phase-1 is already in progress. It is IGBC's largest and most prestigious green rated project with an ultimate built-up area of 7 billion sq.m. IGBC counts a highly conservative figure of 10% - 15% of BUA, to be green rated buildings in new green cities. Dholera has the distinct privilege of being master-planned and PM/CM consultancy is by the world's finest consultancy organization—AECOM. Avinash Misra, Country Head for India and Jagdish Salgaonkar, put their global experience in designing the finest Green City in Bharat. It has earned IGBC's highest recognition "Platinum Green City" rating for design, the very first of its kind. It will be a role model for many similar green cities coming up along India's Industrial Corridors.

2. IGBC Green Cities (Existing)

The Government has announced a brilliant initiative of 100 Smart Cities across Bharat. The objective is that the ancient

cities of Bharat will transform into Smart cities like Barcelona for maximum comfort, safety, productivity, and the health and wellness of its occupants. An area of 500 acres has to be planned and executed in the vicinity of a Smart City. On our request, PM and the Ministry of Housing and Urban affairs (MoUA) agreed to make these IGBC Green (Existing) Cities, laying emphasis on building new infrastructure in harmony with Nature. IGBC has offered to work pro-bono with the CEO of the Green Smart Cites, except that the city has to reimburse the out-of-pocket expenses and man-hour costs. The first Green Smart City of Bhopal has already been registered with IGBC to become IGBC Green Smart (Existing) City and several more are in the pipeline.

Our brilliant author of IGBC Green Cities is Mr. V Suresh, Chairman IGBC Advocacy and Government Policy, Ex CMD HUDCO and Vice Chairman BIS-NBC, who from its inception in the 70s, has combined IGBC Green Cities (New), IGBC Green Cities (Existing) and the IGBC Green Township. These have all been merged into one rating system, which can be tweaked to suit either application.

3. IGBC Green MRTS (New Metro Stations)

Delhi of the 1930s would seem like a glorified village today. The walled city had expanded in all directions and New Delhi was the seat of power. The fastest mode of public transport was a horse-driven carriage, called Tonga. Going to New Delhi meant planning for the whole day. And then came Independence in 1947 and Delhi had to accommodate the displaced people from Punjab.

Slow but steady electric trams arrived along with many an automobile, and buses and trucks carrying freight through Delhi followed suit. In the mid-90s, Delhi Metro Rail Corporation (DMRC) was formed with an equal ownership

by GOI-MoUA and State Government of the Union Territory of Delhi. It was assigned to Dr. E Sreedharan, who has an amazing track record of building Konkan Railways – connecting by train the remotest and inaccessible towns on the southwest coast of Bharat, covering several states. It had brought great prosperity for the inhabitants of these regions.

Unfortunately, Dr. Sreedharan could not stand the pressures of political parties of the-then Coalition Government at the Centre, each with their own vested interest. And DMRC did not take off till the dawn of the current century. The Central Government was elected from a single-majority, well-meaning political party and with it came the great opportunity. The Chief of DMRC demanded that land acquisition would be by the Honorable President of India's sole authority, irrespective of the Central Government, State Government or Lt. Governor. It has been a glorious success, making each one of us proud, with DMRC delivering more than seven lines with 350 underground and overhead Metro stations, each one on time and within a specified budget. Their safety record, highest integrity, and adoption of the latest technology at optimum cost to Bharat, has become legendary for any Public Sector Undertaking.

Dr. Sreedharan, popularly known as the Metro Man, took voluntary retirement due to health concerns, leaving the reins of DMRC in the hands of the equally efficient and honest Dr. Mangu Singh. Mr. Anoop Kumar Gupta, Electrical Director, was selected to assist him. Gupta is a highly respected member of the Executive Board of IGBC and with the help of his colleague Mr. A K Singh, has developed for IGBC, 'IGBC Green MRTS Rating'– the first of its kind anywhere in the world. It is such a masterpiece that developed countries like Hong Kong, Singapore, Australia, even USA want to emulate

it. DMRC is advising USGBC and GBC on the development of LEED for MRTs.

The most satisfying outcome is that more than 3 million commuters of DMRC every day experience the magic of a Green way of life for at least the brief duration of their journey and transit through a Metro station. DMRC has ensured that every single strategy of energy and water conservation, RWH, mini ETP, LED lighting, energy efficient elevators and escalators, and the most efficient water-cooled air conditioning systems for underground stations are installed and operated to maintain the highest IEQ through Demand Control Ventilation.

Their brilliant contribution to Bharat has been lauded by the Central and State Governments, and DMRC has been invited to be consultants for Metros coming up in Cochin, Chennai, Bangalore, Hyderabad, Pune, Mumbai, New Raipur, Jaipur, Lucknow and others. Most Metros emulate the DMRC success story, and they have made their new Metro stations –IGBC Platinum Rated – our highest award.

4. IGBC Green MRTS (Existing Metro Stations)

DMRC had already built 250 Metro stations before the IGBC Green Metro Rating was developed with the expertise of IGBC. Therefore, DMRC had to tweak it to suit the existing Metro stations. DMRC has worked with IGBC to make registration, submission and certification through on-line submission, with zero transfer and waste of paper. DMRC has also got 150 engineers/architects qualified as IGBC Accredited Professionals (APs), and DMRC now has its own green consultants. They are also assessors for IGBC.

Development Of IGBC Rating Guidelines

IGBC has the world's most unique system of developing a rating for each specialized application, and I am proud to share that IGBC rating system remains wholly democratic.

IGBC has an Executive Board comprising all Chapter Chairs, Co-chairs, eminent corporate chiefs, and the best-known thought leaders in the construction industry, who are invited to the Board in recognition of their expertise. IGBC senior leaders nominate the Chairman to head the committee for developing the rating for a specialized application. Since I know every single member of the Executive Board as a personal friend, as Chairman IGBC, I requested the nominated EB member to lead the committee. So far, the consolidated (new and existing) 20 IGBC ratings have been developed by 17 experts from EB and from the field because of their eminence. It is gratifying that, without a second thought, they have all offered their experience and learning to guide the IGBC team. Srini's team from GBC Hyderabad works closely with the nominated Chair of the committee and develops draft guidelines. The Chairman, with the help of the IGBC team, selects his/her committee members from anywhere in Bharat, depending on the person's thought leadership and experience in the specific specialized application.

A draft copy of the proposed rating is sent to all committee members for their preview and comments/suggestions. Committee meetings are held at a location convenient to the Chairman and most committee members, preferably at a CII Office in the region. Depending upon the level of interest shown by committee members, most committee meetings last a full day. IGBC team members make detailed notes and write Minutes of the Meeting, which are then circulated to all committee members for verification,

suggestions, and comments. The Chairman then guides the IGBC team members on incorporating those comments/ suggestions of the committee members that are relevant. A second modified draft is prepared and upon the Chairman's approval, it is circulated to all committee members.

More often than not, the second meeting of the committee approves the modified draft. If there are any further comments or further modifications, agreed by most of the committee members, the final draft, approved by the Chairman is launched, inviting registration of pilot projects. These pilot projects are run for about a year; any improvements or new learning are subsequently incorporated.

The rating is then launched, generally at the next annual Green Building Congress by the Chief Guest, at the inauguration of the Congress, in the presence of the Committee Chairman. IGBC's shoestring budget permits no travel, hotel etc. for committee members, nor for the Chairman of the committee, but that has never been an issue as far as commitment is concerned.

1. Green Certification of Completed Building after Site Visit

Another USP of the IGBC award of certification is that, unlike most councils of the world, the IGBC team visits the completed or partly occupied project on-site, at their own cost, and carries out measurement and verifications. The developer PM/CM, contractor, architect and consultant are invited to join the IGBC team at the end of their visit. The team may not follow the testing and commissioning report by the owner's consultant. The only exception is for long duration (10-20 years) Green City projects. IGBC award for the design of the infrastructure of a building is still awarded upon completion and site visit by an IGBC team.

This has helped IGBC ensure that there is no "Green Wash" from builder/developer—showing an excellent design and availing a subsidy, but not following all the commitments during the actual construction and operation of the building/s.

All IGBC ratings have a validity of 3 years from certification. The project team has to get the award revalidated after 3 years under EB Rating.

CHAPTER NINE

Specialized Application Ratings – Bharat's Green Champions

The key strength of IGBC is the patronage by some of Bharat's greatest thought leaders, having profound knowledge and rich experience of sustainability in their field of expertise.

I am fortunate to have discovered them as friends over the years, working together and volunteering our time, our experience, our learning and often our earnings for the common cause of preserving sustainable life on Mother Earth.

Therefore, when the need arose for documenting the special feature of sustainability in the developing guidelines for each specialized application, I sent a personal appeal to them. The request has been to identify Bharat-centric features in our IGBC rating, of which I have little knowledge.

Combining our already launched 24 IGBC ratings, with existing and new as one, we have 20 independent united specialized application ratings. These have been authored by 17 green champions, and three stalwarts have given us 2 ratings each.

My appeal went to all 17 leaders. Their response has been deeply gratifying for me. Each of their work is based on Indian Codes and Standards, borrowing from International Codes where required. The end-result is regional in character but world-class in standards.

These are presented in the following pages for the reader's delight in learning directly from the distinguished masters themselves.

IGBC GREEN HOMES RATING, 2009

Sharukh Mistry

Chairman, IGBC Green Homes Rating System

I remember the Home Rating system that we drafted in 2008. That day, at Hyderabad, I thought we would have a couple of thousand sq.ft, that the building fraternity would sign up on. By the evening it had swelled up to over a lakh sq ft, and I remember asking my builder colleagues, 'WHY'? Their response was that it was 'the aware users' that are demanding it. I was happy to hear that. And thus started the journey that makes us all proud. Today I was told that we have reached billions of sq ft.

Your vision and leadership, Dr Jain, are really responsible for this stupendous achievement. Most leaders today lead with authority, but you have always done it with 'love, compassion and empathy for all'. I am blessed to have known you for so long. The IGBC 'Green Home Version 3' will be out shortly. We have had an amazing deliberation with representation across geographic boundaries and stakeholders from all disciplines. Listening to them and listening deeply, was a learning experience that I cherish. These different voices brought to the table encouragement, accolades, frustrations, dissent, successes, failures and above all, hope for the future of Green Buildings in India.

We reviewed the certification processes and looked at not only the nuts and bolts of the rating system but also at the larger perspective of the system being able to deliver year on year a dynamic process that allows it to change with the times. Reviewing certification every couple of years is still not mandatory, and I hope we are able to adopt a methodology that allows us to do so in Version 3.

I say this because of reasons. A lot of people confuse the Green Building rating system with sustainable green design. Rating systems are tools for measuring performance, but meaningful green design goes way beyond the brownie points of a rating system. "The soul of the Green Building movement" can never be in its rating system. It has to be in issues of emotion, cultural context, playfulness, empathy, meaning, community, intuitiveness and all the right-brained attributes. These are integral to any good design. But they are intangible and not easy to measure. For example, we still don't know the true value of our forests, rivers and oceans. It simply means that in the natural world, the principles of green are in perpetuity. So, the human Green Building endeavor cannot be a one-stop affair. It is an everlasting cycle.

Simplifying the rating system was another major topic of discussion amongst the participants. Its importance lies in its becoming 'people centric', and user friendly, with the hope that it can be used by the home-owner or builder themselves.

This reminds me of Einstein's words about achieving simpler theories as a driving force in science. He says "make everything as simple as possible, but no simpler". Not shying away from complexity is the other side of the same coin. Green materials and products we realize, have huge potential for our country, encouraging a new branch of industry that will build our 'equitable cities'—cities that are inclusive, allowing people at the bottom of the pyramid to prosper, grow and live with dignity.

We now know that diversity is needed in the Green Home ratings. In the last 10 years there have not only been huge changes in perception but also in acceptability. As they say, what has got us here will not take us there. 'There'—to new frontiers of the sustainability debate. So, maybe it's time to disrupt – to turn it on its head. This might sound too drastic but let me tell you the signs are already visible. There

were suggestions that 'affordable housing' should have a separate rating process. That area of mass housing already shows a huge growth potential with homes for all Indians being seen not as a distant possibility, but in this lifetime, for the majority of our population! The challenges in resource availability will engage everybody to find solutions that are meaningful. This is an occasion that is unparalleled in India's growth story. One hopes that we will have the good sense not to go the 'cookie cutter' way, and have the bandwidth to design according to place, climate, culture and context. Building communities that become participatory to have long-term stakeholding, instead of transitory ownership.

IGBC GREEN FACTORIES RATING SYSTEM, 2009

Pradeep Bhargava

Chairman, IGBC Green (Existing) Rating System

The manufacturing sector all over the world has been reeling under pressures of "continuous improvement" to drive measures around Productivity, Efficiency, Quality, Cost Containment, Headcount Containment, Faster turnaround etc. All these are driven by competitiveness and accelerated technological changes. Hence the concerted drive towards Zero Defect, World Class, Lean manufacturing systems and facilities.

It is in this context of an inward focus, that the concept of going beyond "Lean" came up (when I was planning the new facilities for Cummins at Ranjangaon near Pune). "Lean" looked incomplete, and we went for "Lean and Green". It takes the accountability beyond shareholders, to the larger society and environment, and that completes the stakeholder's expectations.

As the Green Building journey was gaining traction in India, it appeared at the same time that Green consciousness had to go beyond the building, to the complete 'conduct' of the institution. Are you really Green if you use a "red" product in a Green Building? Or even a green product in a Green Building that uses a red manufacturing process? Hence, we worked on creating a code/measure for evolving "Green Factory Rating". This incorporates all aspects of operations of a factory, where environmental aspects are also given due consideration. The elements considered for Green Factory Rating include Energy, Water, Recycling, Renewable, Green vendors, Product Stewardship and so on—all elements that reflect environmental consciousness while setting up

and running a factory. This has since been tested in a large number of cases.

As expected, everyone not only felt good and proud about their being green, but were also rewarded with huge financial benefits, thereby once again establishing the business case for Green Factory. All this substantiates that Going Green is the wiser way forward.

IGBC GREEN EXISTING BUILDING RATING SYSTEM, 2013

Gurmit Singh

National Chairman, IGBC
Chairman, IGBC Green Existing Building Rating System

India is now the world's fourth largest energy consumer, fourth largest source of greenhouse gas (GHG) emissions, and second in terms of annual GHG emissions growth (EIA). As per various reports of the United Nations Environment Program, buildings use about 40% of global energy, 25% of global water, and 40% of global resources. Buildings emit approximately one-third of all GHG emissions and produce up to 40% of annual solid waste. Energy consumption of India's building sector follows similar trends.

At one end of the spectrum are new buildings, which are increasingly becoming energy and water efficient. Simultaneously, at the other end are existing buildings that offer equal opportunities for energy efficiency and improvement in the overall health and well-being of people who occupy them. India has huge existing building stock that can contribute to a significant reduction in both energy and water consumption. Existing buildings are inclusive of buildings constructed in the last decade, as well as heritage buildings that require deep retrofit measures to improve their performance in energy and water. Easy access to energy-efficient technology enables new buildings to achieve higher energy performance with respect to the prevalent codes and standards such as Energy Conservation Building Code (ECBC). However, achieving energy efficiency in existing buildings is challenging. The existing building stock represents significant energy-saving opportunities because

their performance level is commonly far below the current-efficiency potential.

Potential of existing buildings:

> If all existing buildings in India could enhance their energy efficiency, conserve water resources, improve indoor air quality and eliminate waste, it would vastly improve the wellness and lifestyle of their occupants, thereby resulting in significant national benefits. The substantial energy and water saved here can be diverted to other deficit areas. Greening of existing buildings also offers immense untapped market opportunities. It is estimated that by 2025, the Retrofit Potential of Existing Buildings in India would be about USD 25 Billion. Till date, 68 such facilities have been certified across India.

Heritage buildings:

> While it is difficult to achieve energy efficiency in existing buildings, particularly in heritage buildings, several heritage buildings have achieved significant reduction in energy and water usage. Heritage buildings such as Bombay House, Mumbai (100 years old) and Elphinstone College building, Mumbai (120 years old) have established significant reduction in energy and water consumption. These buildings also comply with the energy conservation building code of India.

Existing campuses:

> Like Bombay House, SBI Staff College in Hyderabad became India's first IGBC rated Green Campus, with

a combination of heritage and contemporary buildings on its campus. The campus includes an administrative building, lecture halls, and residential quarters for staff and delegates. This project clearly demonstrates how an existing building, built in early 1970s, can be perfectly dovetailed with latest building structures, to become India's first IGBC rated Green Campus. SBI Staff College has set an excellent example, worth emulating by others, on how an existing campus can set new benchmarks in environmental management. Several such examples are available which demonstrate that green concepts can be adopted by new and existing building stock alike.

Existing building rating system:

IGBC Green Existing Buildings O&M rating system has paved the way for existing building stock to go the Green way. This will go a long way in addressing ecological issues and concerns in a holistic manner. IGBC's Green Existing Building Rating system enables initially non-Green Buildings to adapt to the latest codes and standards. The rating focuses primarily on the operations and maintenance of the building equipment and services. This enables the building to maintain the required energy efficiency, and further improve it by monitoring and analysing the trends of its energy consumption. Apart from energy efficiency and water efficiency, the rating also addresses health and comfort aspects of the occupants. Importance has been given to aspects of occupant's well-being—such as thermal comfort, and wellness facilities like provision for indoor/outdoor sports, yoga rooms, etc.

To conclude, while enhancing energy performance of new buildings is very important, the same importance should be given to enhancing the energy performance of existing buildings. Incorporating green practices in existing buildings can help address national issues like water conservation, energy conservation, reduction in fossil fuel use, waste-handling, and conservation of natural resources. Most importantly, these concepts can enhance occupant health, happiness and wellness. Adoption of Green Building concepts by existing buildings would help India meet its NDC targets while strengthening its energy security at the same time.

IGBC GREEN LANDSCAPE RATING SYSTEM, 2013

Anil Epur

Chairman, IGBC Green Landscape Rating System

Edward O Wilson in his book, *The Diversity of Life* says, 'Biodiversity, the sum of all life on earth, is our most valuable but least appreciated resource'. The renowned evolutionary biologist eloquently describes the diverse species found on earth and the threats that they face today. For many, the term biodiversity is still unclear.

Natural processes like purification of air, maintaining climate stability, protection of water resources, soil formation and its protection, and maintenance of our ecosystem are some of the many valuable advantages we derive from biodiversity. It also contributes to 40% of the world economy, and meets 80% of the needs of the poor, and provides opportunities for medical discoveries according to Convention on Biological Diversity Report.

Today, the ecological message is loud and clear. In our rush for growth, we have failed to adequately factor in its environmental impact. Exploitation of natural resources continues unabated in our drive for industrialization and urbanization. The impacts of man-made climate change are threatening life on earth—a bigger threat than all our wars. Human footprint over the past 50 years has affected 83% of the land area and has disturbed over 60% of the ecosystems. Globally, 50% of the population live in cities, with up to 75% expected to live in urban areas by 2050 (UN 2012). Cities which occupy less than 3% of the land mass account for 78% of carbon emissions, 60% of potable water use and 76% of industrial wood consumption.

No wonder that most cities with their extensive built-up areas are experiencing 'Heat Island' effects. When urban and suburban areas lose naturally-occurring vegetation, heat can no longer escape easily. Tall buildings, concrete and asphalt trap heat and contribute to the warming effect. This in turn contributes to local climate change. The impacts of Heat Island effects can, however, be mitigated by improving the green cover of cities.

The concept of Green Buildings has turned into a mass movement, and with built-up spaces becoming greener, there is now need to look at the spaces outside these buildings. Most gardens and landscapes are full of exotic plants and grass species that require a lot of maintenance—they are water guzzling and need chemical inputs. Lawns with exotic grass species are a very unsustainable practice and a huge drain on our water resources.

Urban landscapes, including parks and gardens, are not to be excluded from the Green movement, and must no longer be resource-intensive. Urban landscapes are rapidly growing, and have the potential to make an enormous positive impact on resource use and sustainability.

A new movement was needed to make landscaping truly Green. This idea led to the initiation of the Green Landscape program and Green Landscape Rating as part of CII-GBC's movement towards environmental sustainability in urban areas. This initiative has also rapidly become a mass movement with leading developers, architects and their associations strongly supporting it.

Urban sustainable landscaping uses native and adapted plant species that are sturdier and require little or no maintenance. CII-GBC has identified 101 such plant species that not only add to the aesthetics of a beautiful landscape but also promote and attract biodiversity, such as bees, butterflies, smaller creatures and birds. In an urban setup, these living

things sustain an ecosystem, and are as important as the tiger is in a forest.

Pollinating insects require a highly varied landscape that provides both foraging and nesting habitats to allow them to successfully complete their lifecycle. Urban landscapes often provide these vital habitats in several ways. Let us give a chance to these bees and butterflies and birds to survive the changing climate of urban areas through green sustainable landscaping.

Let's give biodiversity a chance to thrive alongside us in the cities.

IGBC GREEN NEW BUILDING RATING SYSTEM, 2014

C N Raghavendran

Chairman, IGBC Green New Building Rating System
Chairman, IGBC Chennai Chapter

This is an overview of why, for what purpose, and how, this new and updated rating system for new buildings (NB) was brought in.

Firstly, I must acknowledge the support and guidance from the IGBC leadership; in particular, record my gratitude for the inspiration and ideation that came from Dr. Prem Jain, the Chairman of IGBC, in setting the direction for updating the previous version of the New Building (NB) Rating System. The members of the panel set up for this task contributed immensely, and the discussions and insights received from them and other key members, were invaluable.

The NB was among the first of the rating systems that were developed at the inception of IGBC; a rating system that was India-specific in terms of climate, culture, ethos and economics of new buildings, from the design stage to the construction, occupation and eventual repurposing or outright demolition. This NB, along with the other rating systems adopted in the initial years, proved their relevance and worthiness as the awareness of the fledgling green movement spread widely amongst building sectors to include a variety of building typologies. The spread was noticeable geographically, across the vast Indian subcontinent and amongst varying stakeholders, such as owners, architects, designers, and construction engineers, in a wide array of Building-related professionals, material manufacturers, etc.

But most importantly, by the end-users of the buildings who sensed the benefits of Green Buildings.

An India, with enviable economic and industrial growth, a human development potential that was changing the socio-economic profile of the country and its demographics, with rapid urbanization and growth in infra-structure, was all set for massive growth and development at a global level. Time was ripe for a big first step to upgrade.

All along, IGBC had strongly believed that rating systems ought to be dynamic, responsive to the demands and direction of changes in design sensitivities and technological innovations that were taking place. Besides this, feedback from various stakeholders in the initial years had led to internal brainstorming towards enhancing the potential of NB Rating System to better focus on human welfare, along with environmental care and conservation.

One of the key inclusions was to recognize the knowledge bank of architects and designers on what they considered to be their innate sensitivity towards Passive Architecture. This simply means 'introducing fundamental aspects of Building Physics at the beginning of the design stage to produce an environmentally friendly design that uses natural means, rather than mechanical interventions, to create human comfort. That is, to provide the occupants with comfortable thermal, visual, auditory, and sensory perceptions. There is a great wealth of tradition and knowledge available so that Passive architecture can create comfortable and green facilities without expensive and complicated add-ons. There are numerous examples of outstanding works of Passive Architecture in the past as well as in contemporary times. 'Do the right thing at design stage', and 'Don't create inherent problems in the design stage that have to be solved with external interventions that are not green'—these are the

approaches that architects are trained in. So, why not make this a key feature in the updated NB Rating System?

This, I think, is the most important element added in the revisions.

Here I must acknowledge and appreciate the keen insights very forcefully put across, not by architects who consider Passive Architecture to be their exclusive domain, but by an outstanding technologist, thought-leader and a pioneer in the Indian HVAC field. How come a mechanical engineer could be sensitive to architectural practice that excelled in India for millenia, and is currently under trial and adaptation?

He is none other than our dearest and revered champion of Green Movement, the late Dr. P.C. Jain. I sometimes think that his years of teaching students of Architecture at the School of Planning & Architecture, New Delhi, have borne fruit. As an architect of five active decades in the profession, and as the Head of the NB Rating System Committee, I salute Dr. Prem Jain.

IGBC GREEN CITIES RATING SYSTEM, 2015

V Suresh

Immediate Past Chairman, IGBC
Chairman, IGBC Policy and Advocacy Committee and Government Relations
Chairman, IGBC Green Cities Rating System

Toolbox for building a greener and healthier India

IGBC envisions facilitating 10 billion sq.ft of Green Building footprint by 2022. Greening of cities will go a long way in realizing this aspiration, and IGBC has launched an exclusive rating system for the greening of upcoming and existing cities which is one of IGBC's 22 rating systems.

The 'Green Cities' concept seeks to promote eco-friendly cities that balance social, economic, and environmental dimensions; has good urban governance as its foundation; makes optimal and efficient use of natural resources like water, energy and land; thereby leading to sustainable built environments.

Dholera Special Investment Region (DSIR) is an upcoming new industrial city, planned to be developed as an integrated and self-contained city. Some of the significant features are Compact City Development, Efficient Urban Mobility, Social Infrastructure, City Landscape, and Green Infrastructure.

The city has been the first greenfield industrial city in India to adopt the IGBC Green Cities Rating framework for its Master Plan, and has been awarded the prestigious IGBC Platinum Rating.

Sri City, Andhra Pradesh, is a multi-product SEZ with a vision to create a world-class business destination, with perfect harmony between Industrial Growth and Sustainability. Some of the significant features are reliable power 24x7, water resource management, dedicated storm-water and sewer

network, integrated waste management, and ICT support. The city has achieved the IGBC Green City 'Gold' rating.

The new capital city of Amravati has integrated planning with the idea of environmental sustainability, social inclusion and inclusive participatory approach. The distinctive features are Blue and Green Master plan, accessibility, and well-being, with the goal of a 5-10-15 minute walk for access to various services.

On similar lines, GIFT City and Mahindra World City have been included as Green Cities.

Brownfield Cities

After the launch of the 100 Smart Cities program by the Government of India, it was observed that most were brownfield existing cities with projects to upgrade existing facilities and amenities. Responding to the same, IGBC brought out the Green Cities Rating System for existing cities.

This rating has the pan city approach for enhancing all infrastructure facilities (Physical, Social and Economic), and new Area Based Development (ABD), to provide a good representative model for creating Green Cities with efficient and smart infrastructure development.

The key benefits are: air quality improvement, reduced energy demand by 20-30 %, enhanced water efficiency by 30-40%, waste segregation and recycling, ICT and e-governance for ease of making available all services—thereby ultimately enhancing the quality of life for cities and citizens.

The two Smart Cities of Bhopal and Vishakhapatnam have been included as initial pilot projects. Other Smart Cities are already on the anvil for inclusion under IGBC Green Cities, under Existing Cities category – ultimately leading to Smart, Safe, Sustainable and Green Cities.

IGBC GREEN SCHOOLS RATING SYSTEM, 2014

Jaimni Uberoi

Chairman, IGBC Green Schools Rating System
Chairman, IGBC Jaipur Chapter

The Green School Rating has been developed keeping in mind our future generations. Green Schools touch upon important environmental subjects that would inculcate the concept of sustainability in young minds. It is a great learning experience for students who prepare to lead the world towards a healthier, cleaner and sustainable future. Involvement of young minds in our efforts towards sustainable development can lay a strong foundation and play a catalytic role in transforming Bharat into 'Jagat Guru', which was the dream of our Chairman, Dr. P C Jain.

Statistics suggest that there are over 13 crore children aged between 6 to 13 years in India, which is more than 10% of the entire population of the country; and children between 11 to 13 years number about 7.2 crore. This underlines the importance of involving children in the Green Building movement. It is solely our duty to gift the cleanest and greenest environment to our younger generations.

The Green Schools Rating provides important opportunities for students to become engaged in real world issues that transcend classroom walls. They can see the relevance of classroom studies to the complex environmental issues confronting our planet, and they can acquire the skills they would later require in addressing environmental challenges. IGBC's Green School mission aims to transform the complete education system, and includes school children, their mentors and the families associated with schools. The IGBC Green Schools Rating System was developed in 2015,

and as on date, more than 70 schools across the country have been certified for Platinum, Gold, Silver and Certification ratification levels. IGBC certified Green Schools adopt a holistic approach towards incorporating Green Building features for environmentally friendly development, and are spearheading the Green Schools concept in their vicinity, neighborhoods and region. The Green Schools Rating addresses eco-education, health and hygiene, in addition to infrastructural facilities, energy efficiency, water conservation and waste management. Aspects like nutrition, physical activity and safety are also addressed.

Green certification of schools in various parts of the country has demonstrated how our students and their teachers have celebrated HAPPINESS. IGBC's vision to become a sustainable leader by 2025 and enable 'sustainable built environment for all' can be achieved with the support of our children.

IGBC GREEN MRTS RATING SYSTEM, 2014

A K Gupta

Chairman, IGBC Green MRTS Rating System

Dr. Prem C Jain is widely recognized in India and across the world for his path-breaking and visionary contributions to the Green Building movement.

DMRC's partnership with IGBC has paved the way for the launch of the world's first comprehensive rating system for rapid transport: the Green Metro Rating System in 2014. This has in many ways demonstrated India's thought leadership in adopting and promoting sustainable measures in mass urban transportation.

Managing Director DMRC, Dr. Mangu Singh said, 'We are pleased that DMRC is one of the Founding Members of IGBC and is playing a vital role in promoting Green Metros in the Country. We are indeed happy to share our expertise in developing IGBC Green MRTS Rating System. Undoubtedly, this is one of the greatest contributions of India to the global community.'

Dr. Jain's visionary and astute leadership resulted in the registration of over 390 Metro stations across the country, with many more in the pipeline. A charismatic leader, he brought out the best in both individuals and teams. I have personally worked with him and am pleased to have been associated with him on this journey.

IGBC Green MRTS Rating has been developed with the support of key stakeholders from Ministry of Urban Development, Metro Rail Authorities, General Consultants, Contractors, Technology Providers, Metro Rail Operators and Green Building Consultants.

This rating system is a tool to enable new rail based MRTS to apply green concepts during design and construction, so as to further reduce environmental impacts that are measurable.

DMRC- IGBC partnership, an idea which germinated at IGBC, was due to the untiring efforts of Dr. P C Jain. I had great admiration for him, and his presence shall always be felt for a long time to come.

IGBC GREEN INTERIORS RATING SYSTEM, 2015

B. R. Ajit

Chairman, IGBC Green Interiors Rating System
Chairman, IGBC Cochin Chapter

To begin with, I would like to thank Dr PC Jain very much for the confidence bestowed upon me by asking me to Chair the Green Interior Rating System for IGBC. The journey with IGBC, and as the Chairman of this well-articulated rating system, began in April 2015, and, since then, it has been one of the most pleasurable and satisfying experiences for me, the memory of which I shall forever cherish.

I fondly recall and appreciate the support extended by my fellow architects Ar. Nitin Saolapurkar and Ar. Leena Kumar in the development of the rating and in helping us lay an excellent foundation. The Green Interior Rating benefited immensely from their suggestions and inputs.

The IGBC Green Interior Rating was formed with the objective of helping the greening of projects which could not abide by Green Building norms and guidelines, during the construction of the core and shell. It is commonly observed that approximately 50% of the cost of construction is most often incurred for interiors, hence it is important to look into green interior design and construction for the benefit of the project, and to responsibly use resources. Green interiors can help improve the Indoor Environment Quality immensely and contribute positively to the well-being of the occupants. 90% of the time people stay indoors. Therefore, indoor aesthetics, air quality and comfort are of paramount importance to occupants. Sustainable Interior design can result in multi-fold benefits such as 30% - 40% reduction in energy cost, 20% - 30% reduction in water requirement,

enhanced indoor air quality, non-toxic indoor materials, enhanced ergonomic and acoustical comfort and improved daylight—to highlight a few.

Since its inception, the Green Interior Rating has serviced various building typologies such as commercial, office interior fit-outs, malls, retail spaces, hotels, restaurants, resorts, IT spaces, banks, hospitals and many other buildings. It is my firm belief that this rating is the key to achieving greener and healthier internal built environments, and has an important role to play in achieving our shared goal of facilitating India to be a global leader in sustainable built environment by 2025.

IGBC GREEN RESIDENTIAL SOCIETIES RATING SYSTEM, 2015

Mala Singh

Co-Chair, IGBC Green Residential Societies Rating System

The pace of exploitation of natural resources in urban India is high and is reaching critical limits. Hence, the creation of New Green Buildings and Smart Cities have become of utmost priority to achieve sustainability. However, the focus on New Green Building development will not be sufficient to transform existing built environments into healthy, vibrant and green environments. There is an urgent need to nurture and implement green and sustainable practices in existing buildings and operational housing societies.

Residential development contributes to the majority of construction in India, in the form of housing societies, apartments, stand-alone buildings, etc. Keeping this in mind, adopting Green Building norms and guidelines to transform existing residential buildings, housing societies, colonies, and multiple-dwelling communities into green societies would propel and benefit the Green Building Movement in India immensely.

Existing buildings which were not built responsibly pose the biggest challenge in the path towards sustainability as they were built in times when environmental conservation was not a pressing concern. With this background, the Indian Green Building Council (IGBC) formed a Technical Committee to establish the Green Residential Society Rating System for existing multi-dwelling residential buildings. The Committee, through various deliberations, has come up with a Pilot

Rating to establish certain standards in designing sustainable residential societies. This has been developed considering the Indian context and the national priorities.

The IGBC Green Residential Society Rating System not only gives importance to standard Green Building practices such as segregation and disposal of waste, green education to residents, water efficient plumbing fixtures, rainwater harvesting, special provisions for the differently-abled, and mitigation of urban Heat Island effect, but also rewards exemplary practices such as collection and disposal of e-waste, facility management, use of LPG/CNG geysers, installation of sensors, etc. This unique rating system also gives a lot of importance to resident participation, knowing that green education, community participation and voluntary initiatives will help bring about the much-needed transformation in our urban infrastructure.

Using a conventional yet innovative approach, the IGBC Green Residential Society certification proves that any building's initiatives towards resource efficiency can, in turn, create a healthier society.

Many existing buildings across the country have adopted this rating. As on date, 20 million square feet built-up area of residential societies and existing buildings has been certified under IGBC's Green Residential Societies Rating System. Today, with the changing face of the Green Building industry in India, the Indian Green Building Council is now in talks with local governing bodies and municipal corporations so that green residential societies may avail of incentives such as property tax rebates.

The IGBC Green Residential Society Rating system is the first of its kind in India to foster 'Green Concepts' in existing residential buildings and housing societies that

complement initiatives such as Swachh Bharat Abhiyan, Make in India, Solar Energy Mission and Clean & Green India, for a better present and better tomorrow. By taking care of the environment, its conservation and sustainability in day-to-day life, a green residential society will help to underline the importance and benefits of Green Living.

IGBC GREEN CAMPUS RATING, 2015

Jayesh Hariyani

Chairman, IGBC Green Campus Rating System
Co-Chair, IGBC Ahmedabad Chapter

Institutions and large campuses characteristically have a distinct mix of high-density resource use with temporariness of usage. Given the nature of large campuses with a high number of people concentrated in one space over a given time of the day, the resource consumption and the impact on built space is very different from that of other buildings. Further, campuses often have multi-use buildings that cater to different functions and needs of the campus. Hence, the measure of their sustainability greatly differs from that of a residential standalone building.

With the growing trend of large campuses that offer one-stop solutions for corporates, and educational campuses that strive for holistic learning environments, it is imperative that sustainability is integrated in developing them. Further, as resource consumption in large campuses increases with the increase in density of people therein, it is imperative that existing and old campuses also come under Green Compliance.

The IGBC Green Campus Rating System has a separate rating for New Campuses and Existing Campuses, acknowledging the needs of new campuses and the constraints of existing campuses. Some of the unique aspects addressed in this rating system are: optimization of water use for construction, improving lung wellness on the campus by emphasizing green cover, encouraging more Green Buildings on the campus, effective management of waste, promotion of bicycles as a mode of transportation, and

encouraging facilities for improving the health and well-being of its occupants.

Green concepts in campuses can address many issues regarding energy and water efficiency, reduction in fossil fuel use, wastewater management, and conservation of natural resources, to achieve a sustainable society. To be creditable in the role of creating a better society, educational campuses have to be more sensitive towards, and aware of, their built environment, and its efficiency. Green campuses can have tremendous benefits, both tangible and intangible. The most tangible benefits are the reduction in water and energy consumption right from day one of occupancy. Energy savings could range from 20 -30 % and water savings around 30 - 50%. Intangible benefits of green campuses include the health and well-being of occupants, enhanced air quality, and increased biodiversity.

Initiating a green rating system designed specifically for large campuses goes a long way in enlarging the green footprint of the built-scape. In a campus environment, a sustainability initiative has the potential to engage with a wider audience. In an educational campus, it also offers unprecedented opportunities for applied research to combine with classroom training and community service, creating a rich service-learning environment with strong links to the community in which the university resides.

IGBC GREEN HEATHCARE RATING SYSTEM, 2016

R. Chandrashekar

Chairman, IGBC Green Healthcare Rating System

Indian healthcare industry has undergone rapid advancement. This has made recovery and recuperation of patients faster, thanks to the prowess and skills of the medical fraternity. From 2010 to 2017, the Indian healthcare sector grew at the rate of 16% and is expected to reach USD 280 billion by 2020.

Apart from the advancement in medical technology, tremendous growth in healthcare infrastructure has been witnessed. However, healthcare infrastructure continues to face a number of challenges, particularly with respect to providing quality, affordable and resource efficient healthcare services to all. They are energy guzzlers, consume massive quantities of water, generate large quantities of waste, and produce high levels of indoor pollutants, thereby resulting in enormous environmental implications.

Against this backdrop, IGBC developed the Green Hospital Program and launched a rating tool that can be adopted by healthcare facilities. The entire framework consists of green parameters that focus on designing a healthcare setup that is resource efficient and provides comfortable environmental quality to patients, visitors and doctors. The key features of the rating program include concepts of healing architecture, indoor air quality, ergonomics, acoustics, healthy materials, passive strategies, bio-medical waste management, infection control strategies, etc.

Green healthcare facilities have tremendous benefits, both tangible and intangible. The most tangible benefits are reduction in water and energy consumption right from day

one of occupancy. The energy savings could range from 20 to 30%, and water savings around 30 to 50%. The intangible benefits of green healthcare facilities include enhanced air quality, faster patient recovery, day lighting for patients, connectivity to outdoor environment, better health, and better hygiene of occupants.

Further, the tool also addresses national benefits. It helps to reduce resource consumption (power and water), address sustainability aspects in healthcare facilities, augments healthcare policies of the country, minimizes hospital-acquired infections (HAIs) and ultimately enhances public health.

The sector is expected to grow several-fold in the next decade. The healthcare sector in India is growing at a rapid pace, contributing immensely to the growth of the quality of services. While this augurs well for the country, there is an imminent need to incorporate green concepts and techniques in this sector, that can aid growth in a sustainable manner.

As a stepping stone, the Ministry of Health & Family Welfare, GoI, has commenced a green initiative by mandating all upcoming AIIMS facilities to adopt the concept of green hospitals. Adopting IGBC Green Healthcare Facilities would enable more and more hospitals in going the green way. This would ultimately facilitate the goal of a greener and healthier India!

IGBC GREEN PLACE OF WORSHIP RATING SYSTEM, 2016

Syed Mohamed Beary

Chairman, IGBC Green Place of Worship Rating System
Chairman, IGBC Bangalore Chapter

God has created the universe in perfect balance; Don't ever tamper with this.

I was born and brought up in the lap of Mother Nature in Kodi, Kundapur (West coast of Karnataka), on the shores of the enchanting Arabian Sea, amidst blue skies and sun-kissed golden sands beautifully shaded by coconut and casuarina groves.

My early years and best childhood memories belong to this picturesque hamlet with my parents, who truly believed and practised sustainable living. My late father, a teacher and an environmentalist in every sense of the word, instilled in us a love for Nature, and the Quranic words (quoted above) taught by him became my lifetime inspiration. My journey on the 'path of green' began right there.

Through Bearys Group and Bearys Education, God gave us the opportunity to carry forward our vision and mission which is in sync with IGBC's vision of furthering the Green Building movement and encouraging the developer community to participate in environment protection, through Green Building architecture and sustainable development. From inception 'Sustainable Green Development' is at the core of all our work, something we carry forward with passion and conviction for projects that are architecturally significant, functionally sound, environmentally conscious and offer the highest value for investment.

IGBC is vigorously spreading the message of green development, resource conservation, caring for and protection of the environment. Its rating system focuses and highlights important aspects of sustainability. It sets high standards, creates awareness and motivates stakeholders at all levels to achieve excellence in sustainability. These standards truly encompass green development and are easy to implement.

While the Green Building movement has taken great strides and caught up well with the top rung of society, the challenge ahead is to bring it to the middle segment of the pyramid, which is the largest segment and therefore, can make a great impact and difference. On this score, IGBC has introduced IGBC Green Housing Society Rating System which is simple and easy to adopt. With this, large housing societies now come under its purview. In addition to offering many tangible benefits, it also contributes to higher productivity and ultimately, healthier societies.

It is gratifying to note that we designed and constructed a Green Mosque in Kodi, one of the first places of worship to go green in the country. It was awarded a Platinum rating. It was Dr Jain's vision to take green concepts to all places of worship across the country. The IGBC Green Place of Worship rating has been well received across the country. Many temples, churches and gurudwaras are going green today.

IGBC has taken the lead in advancing the Green Building movement, and very soon we will be able to translate the vision of Dr. Prem Jain Saab into reality—achieving 10 billion sq.ft of green foot print in the country. The motto of Bearys Institute of Technology—Purity of Heart & Clarity of Mind—was truly imbibed from his thoughts and actions. We shall remember him forever.

IGBC RATING FOR SPECIALIZED APPLICATION – RAILWAYS, 2016

S. Raghupathy

Deputy Director General, CII
and

K. S. Venkatagiri

Executive Director, CII – GBC

'Indian Railways has a central role in connecting our nation. It is truly the lifeline of our progress.'

—Hon'ble Prime Minister Narendra Modi on 163rd Foundation Day of Indian Railways.

'*Railways is naturally a Green mode of transport. We want to make it further Greener by adopting Renewable Energy as a major source of Energy for Railways.*'

—Shri Piyush Goyal, Hon'ble Minister of Railways, Govt of India

The Indian Green Building Council (IGBC), part of CII, has been closely engaged with Indian Railways in its efforts to green its operations. Activities undertaken under this engagement include greening of various buildings of Indian Railways such as its offices, hospitals, training centers, schools, etc.

The leadership and encouragement of Dr Prem C Jain, Chairman, IGBC, has led us to make major strides in facilitating the greening of Indian Railways.

One of the focal points of Indian Railways is the 7,300 railway stations spread over 121,000 kms of rail network all over the country. These railway stations, while being major consumers of resources (electricity, water), and generators of waste, also offer an opportunity to engage with the 24 million passengers who pass through these stations every day.

Against this backdrop, and thanks to the excellent support of the Environment Directorate of Railway Board, IGBC developed an exclusive green rating methodology for Indian railway stations. This rating was released by Shri Suresh Prabhu, the then Minister of Railways, at Green Building Congress 2016 on 8th October, at Mumbai.

As on date, seven railway stations: Secunderabad, Jaipur, New Delhi, Katra, Chennai, Varanasi and Howrah have been rated by IGBC, while 25 more railway stations are working towards becoming green.

Some of the unique green features implemented at the IGBC rated green stations include Grid Connected Solar PVs installed at station rooftops, 100% LED lighting, 100% BLDC/BEE 5 star rated fans, no Centralized Evaporative Cooling in large general waiting halls, heat reflective coatings on rooftops, 90% low-flow water fixtures, 100% treatment and reuse of waste water from the station and coaching yard, a bio-methanation plant to convert food waste to cooking gas, and an Automated Coach Washing Plant.

Some stations have taken up green initiatives with enthusiasm. For instance, Secunderabad Railway Station has upgraded its facility and became India's first IGBC Platinum Rated green railway station. We expect about 600 green railway stations by 2022.

In order to give a policy thrust to the entire initiative, and to reach out to the entire country, Indian Railways has issued a Policy Directive to all its 16 zones for greening their existing

office buildings, industrial units, major railway stations, major railway hospitals, railway schools and Training Centers.

We expect this to result in large scale adoption of green/ environment initiatives across the country, making Indian Railways a green transporter as envisioned by the Hon'ble Prime Minister and Hon'ble Railways Minister.

IGBC would like to thank Shri Suresh Prabhu, Shri Piyush Goyal, Shri Swaminathan, Shri AK Tewari and other members of Indian Railways for extending their support and guidance in the greening of Indian Railways.

IGBC GREEN AFFORDABLE HOUSING RATING SYSTEM, 2017

M. G. Somashekar

Chairman, IGBC Green Affordable Housing Rating System
Chairman, IGBC Mysore Chapter

Let me first express my sincere gratitude to IGBC and its selfless leader Dr Prem ji, for reposing his confidence in me to work with IGBC for the formulation of the IGBC Green Affordable Housing Rating System.

Unlike other rating systems, this rating had dual challenges. The first challenge was that the measures suggested had to be affordable. The next challenge was to make it available. Both these have been addressed to a large extent.

The development of Green Affordable House Rating is a sincere effort made by IGBC, to bring in a Bottom-Up approach. This would mean that the last person in India would go green when he thinks of a shelter. I feel it is pertinent to recall Mahatma Gandhiji's message when we got Independence: 'I shall consider India as a developed country only when the last person of this country gets shelter over his head'.

A committee was formed with experts from different areas of Green Building expertise. The rating is an outcome of all the hard earned and rich experience of the committee members. My sincere gratitude to the beloved members of the committee for contributing their precious time and sharing of knowledge.

Every criterion addressed in the rating is easily achievable. One of the methods of making homes affordable is to

introduce the latest technologies during construction, and to a large extent this has been addressed.

Affordable Housing would touch the lives of people even at the bottom of the social pyramid. We saw this as an excellent opportunity to reach the common man. I would like to take this opportunity to thank Dr. Prem ji immensely for his encouragement and support in IGBC's efforts in the area of Affordable Housing, which will grow manifold in the years to come.

IGBC HEALTH AND WELL-BEING RATING SYSTEM, 2017

Kamal Meattle

Chairman, IGBC Health and Well-being Rating System

One is happy and productive when one is healthy – wellness is the key to productivity and success.

Our focus has rightly been on Green Certified Buildings for a sustainable future. We must also focus on the health and well-being of the occupants of the building, for whom these buildings are built in the first place. 95% of the cost of any organization in the Knowledge Economy is related to People Costs. We need to pay more attention to the health and well-being of people, to be able to get the best from them, and hence win in this deeply competitive world.

Organizational success, of course, has been achieved without designing for wellness, but the human cost of that strategy has not been assessed comprehensively, nor included in any organization's balance sheet. Commercial Real Estate professionals (CRE) need to take a holistic view and not only focus on 'Rent' and 'Energy Efficiency.' The work environment should help bring out the best in us, and this can be done only through a planned process and design of the built environment. This includes the quality of air, water, light, comfort, food, exercise, safety, recreation, and a feeling of belonging in a community. In order to translate this into workplace design, the physical and psycho-social factors that affect employee health and well-being have to be accounted for.

Winston Churchill had said, 'We shape our buildings; thereafter they shape us'.

It is so apt, since 90% of our lives is spent indoors, inside buildings. Buildings can assist us in improving our cognitive ability, productivity, and wellness, while keeping us safe so that we can achieve our full potential, as measured and tested by Harvard Center for Health and Global Environment, and published as a study.

At Paharpur Business Centre (PBC), New Delhi, we have experienced over the past 25 years, that if one stays indoors inside the building for around 8 hours, there is a 42% probability of one's Blood Oxygen Level going up by 1%. This is significant, given that our brain weighs only 2% of our body weight but uses 20% of the oxygen we breathe. We at PBC grow our own oxygen and fresh air, with the help of our over 7,000 indoor plants!

India has a program to build Smart Cities. We are in need of Smart buildings with Smart people. For people are the most valuable resource for any country or organization. We need to map out the productivity increase benefits of occupying a Green Building. A small increase in individual productivity leads to significant gains for an organization.

Wellness leads to fewer sick days, and results in a motivated work force. This is besides the improved energy efficiency of the building resulting in lower OPEX, if one were to replicate the IAQ practice at Paharpur Business Centre. Our average annual energy consumption is under 17whr/hr/m2.

Occupant satisfaction should be measured periodically. A small increase in individual productivity leads to significant monetary gains for an organization.

Understanding that there is an intricate relationship between occupant's health and well-being, and the built environment, Dr Prem Jain, Chairman IGBC, rightly decided that it was time we worked upon CII–IGBC Health & Wellbeing Rating for the built environment. This is the first of its kind of a Green Building rating system in India. His

farsighted vision has been to enable Bharat to shine in an affordable manner!

This rating system addresses the physical, intellectual and social well-being of building occupants. The objective of the rating is to facilitate buildings to incorporate people-centric measures for enhancing the health and well-being. Its framework will enable organizations to address various aspects such as indoor air quality, water quality, hygiene parameters, healthy food choices, and lifestyle at affordable cost.

Going forward, this is a great opportunity for buildings, both existing and to be built in the future, including schools and residences, to make us and our future generation smart, happy, healthy, and help them reach their full potential.

With this we hope that the Dr Prem Jain's wish for a Happy, Healthy, Smart, Sustainable, Productive and Green India is realized by 2025.

IGBC GREEN NET-ZERO BUILDINGS, 2018

Ashish Rakheja

Chairman, IGBC Green Net-Zero Buildings

Energy and water conservation have always been key concerns for buildings all over the globe. While water is a naturally available resource, energy presents a challenge in terms of generation, transmission and consumption. Energy conservation has therefore been a driving factor for the Green Building movement and commands the largest number of credits. All subsequent versions of green rating systems as well as Equipment/Building Energy Labelling programs by the Government have progressively raised the benchmark for energy conservation.

Globally, buildings account for over 40% of the energy produced in the world. Since the advent of the Green Building movement, energy conservation in buildings is regarded as low hanging fruit that presents the opportunity of lowering carbon emissions as well as minimizing environmental degradation caused by the burning of fossil fuels. Most countries are signatories to the Kigali Agreement, and are bound by the target of lowering carbon emissions to help contain the threat to human existence due to global warming. Both Governments and United Nations (UN) have identified refrigerants used in HVAC systems, and Energy Efficiency of Buildings as prime areas of focus to meet environmental commitments.

Humankind has always enjoyed the availability of abundant renewable energy (RE) sources. However, availability of cheaper fossil fuels prevented the full utilization of RE potential. With growing concerns over

rapidly rising energy demands due to urbanization of Third World countries, which account for more than half of the global population, and depleting of fossil-fuel reserves, the focus is once again on harnessing renewable energy sources. Most developed countries have already set their course towards harnessing renewable energy sources like Solar, Wind and Geothermal. Significant investments are being made in the next decade, and India is regarded as a leader in this area.

The continuous reduction in building energy usage coupled with the increasing use of renewables has shifted the focus towards Net-Zero Energy Buildings (NZEB) which can be potentially grid independent. India embarked on its journey of constructing NZEB in the last decade and has an impressive line-up ranging from Offices, Homes, Airports, Train/Metro Stations and Campuses. Each of these buildings has scored high on Green Building rating scale but did not get due recognition.

NZEB Rating System is therefore a natural progression which starts by defining the term, and thereafter looks at both energy efficiency as well as the use of onsite and offsite renewable sources. Emphasis is given to onsite renewable generation, and it incentivizes buildings to reduce consumption. The rating system focuses on the design and operation of buildings and is dynamic in nature—so that NZEB status can be denied in subsequent years if consumption surpasses generation. The focus of the rating system is to recognize buildings that take the energy efficiency route to reduce consumption rather than deploying the power of renewables to meet the end objective. The rating also bridges all leading Indian and global standards like NBC, ECBC, ASHRAE & ISHRAE.

IGBC is a member of the World Green Building Council (WGBC) which too has set its course for promoting NZEB. India leads the pack and will probably be the first country to have its own NZEB rating program.

The NZEB Rating System has been hailed as the mother of all ratings as it is aspirational and sets the path for future generation of buildings.

Chapter Ten

IGBC Gives Wings To My Junoon To Serve Bharat

'Happy families are all alike; but every unhappy family is unhappy in its own way.'

More than 250 years ago, the great Russian master Leo Tolstoy gave us a profound thought in his masterpiece Ana Karenina. I read it 60 years ago during my studies at Banaras, but it still rings loud and clear in my mind. Inspired, IGBC proclaims: '*IGBC Certified Green Buildings are all alike'*.

There are 5000 projects registered with IGBC with a green footprint of 5.7+ Billion sq.ft. Promoter teams of each project (except those for personal use) showcase how they have walked the extra mile to make the project sustainable, and in harmony with Nature. Even at the cost of a marginal cut in the promoters' commercial gains, the project provides improved health and well-being of its occupants, conserves the physical resources of Mother Earth, her natural resources of energy, water and air, and creates negligible waste by complete recycling.

Each such project, large or small, makes its contribution for 'Bharat's way of life will be Green', and we will leave behind a legacy of preserving all life on Mother Earth. Our younger generations and generations not yet born, will enjoy the bounties of Nature forever.

This is how we are tirelessly striving to walk on the Path of Green in a multitude of ways, working out solutions to restore the natural balance in every way possible.

I strongly believe that India will lead the world in sustainability in the near future.

Painting by RENU JAIN

Thou hast made me endless, such is thy pleasure
This frail vessel thou emptiest again and again,
And fillest it ever with fresh life.
Thy infinite gifts come to me
On these very small hands of mine
Ages pass, and still thou pourest, and
Still there is room to fill.

*

Because of the Tapasya of countless ages past,
This creeper has bloomed in the lap of earth today.
This picture of joy lay hidden in the folds of the unknown.
Likewise in my dreams, in the grove of a far-distant spring
Shall bloom a smile on the face of dawn –
This hope slumbers in the depth of my being.
—Rabindranath Tagore

Milestones And Influences

FOUNDING SPECTRAL

I started my own venture Spectral Services Consultants in December1980, on the principles of dharma, total transparency and the offer of the finest MEP system, specially designed for each assignment. We also took unconditional responsibility of delivering projects, strictly according to their design, irrespective of the implementation agency chosen by the project management company or the owner.

Spectral Consultancy was founded with my GK home as the registered address. Ma's teachings were simple, 'Only the best counts, the rest is passing. Any institution based on dharma, truth, integrity and humility will blossom, no matter how adverse the circumstances are.' 'Truth always wins.'

Spectral followed my mother's teachings as if they were the Guru Mantra. Starting with four people in 1980, we grew to 600 people with nine offices in India by 2011. Spectral was recognized by its peers as the number one privately owned consultancy firm.

The secret of Spectral's success was that I was the head of the Spectral family and not an employer; I was involved in sharing the agonies and ecstasies of my colleagues, giving them total freedom. We had a passion for excellence in design, took unconditional responsibility for our design and treated vendors, suppliers, manufactures and contractors with respect, as our equals. If one of the difficult clients did not pay, we still completed his project, with the vow not to work with him again, but never took a legal path, as we believed "Customer is Always Right".

The fundamental pre-requisite of our design was energy and water conservation, and minimum waste generation through recycling. All these we have practised since 1980, therefore when certified Green Buildings were brought to Bharat in 2003, we already had hundreds of projects all over India, which fulfilled most of Green Building Norms laid down by IGBC.

Then the Asian Games came to Bharat. Before we could furnish the office, and with only four of us, six major projects for the Asian Games - hotels, stadiums and office buildings landed in our lap—all with a two-year deadline. Ma's blessings made it happen. I had many glorious innings with Stein and Doshi in the last nine years and through word of mouth, our passion and high integrity had come to be recognized and respected.

In 1980, hotels were paying 20% of their revenue for heat, light, and power (HLP). Spectral underwrote that our designs, without any major additional cost, would yield HLP of 12% or less. This was our USP - conservation of energy, water and fuel, and no waste. Hotel owners were charmed, and we ultimately worked on 250 and more hotels across the country, delivering HLP of 10% or less. We were kings in consultancy and had the first right of refusal when Hyatt,

Marriott, Shangri-La, Accor and other major international chain of hotels entered India.

We were excellent in design and delivery, but poor at finances. God in his infinite mercies gave me a son, Manish, Payal's husband; he is a finance wizard. We never had any savings in our bank due to large write-offs. I ran Spectral with 100 colleagues as a family, but Manish saw our huge goodwill with clients – the Who's Who of Bharat. He expanded our two offices into nine offices across India, institutionalized our operation with CTOs and Directors. Our turnover grew exponentially from 1998 to 2011, thanks to Manish's financial acumen.

Manish wisely decided that since Spectral was the premier consultancy in Bharat, with marginal presence outside, we had already reached the zenith. He engaged consultants to find a merger partner and the World's no. 1 consultancy, AECOM came looking for us. He single-handedly presented Spectral's financial and professional credentials to a due diligence team of experts from USA, Europe, Australia and Hong Kong. Our impeccable, litigation-free performance of 32 years, with 250 Who's Who clients across India, and their clear admiration, made the task easier. The merger was concluded within two months and on 11 June 2011, Spectral merged with AECOM India.

The proceeds from the merger were substantial and a huge chunk was distributed amongst our 600 family members of Spectral. Even the support staff of drivers, peons, receptionists and secretaries received the reward for their loyalty to Spectral, and they used it to build houses or live out personal dreams of their own. It has been deeply gratifying for me.

HONOR OF NOMINATION AS THE FLAG BEARER OF GREEN CARAVAN

Our charismatic Founding Chairman, Mr. Parasuraman (Parasu) is a stalwart of CII in Bharat's southern region. With his benevolence, as MD of a large MNC, he has many friends in the corporate world, and amongst eminent architects and interior designers. Therefore, the awareness regarding IGBC and Green Buildings has slowly climbed up.

Parasu got a fabulous opportunity to head an MNC Corporate Office in Dubai and decided to move his base to Dubai, leaving IGBC headless, but in safe hands. I was born on 26th January, 1936, and am the eldest amongst IGBC Members, but young at heart and mind. The GBC board, headed by Jamshyd Godrej nominated me to be the flag bearer for the entire IGBC family of brilliant, dedicated thought-leaders.

It has been an honor and responsibility par excellence; it has given wings to my 'junoon' of serving *Janani Janmabhoomi* Bharat, with single-minded devotion. I could stand on the shoulders of giants like Jamshyd, Parasu, Kath, Raghavendran, SRP and Srini, and reach for the stars, fulfilling my Ma's teaching—'Only the best counts'.

Awareness regarding IGBC and Green Buildings remained with well-meaning corporates and professionals. Our scoreboard of the registered green footprint with IGBC was tottering at around 40 million sqft.

I had the vision on my birthday of how we could motivate our one billion plus population to help IGBC become the global leader. We made the IGBC motto: 'Every person in Bharat to contribute 1 sqft only of registered green footprint', taking us to 1 billion sqft by 2015.

Jamshyd Godrej (JNG) gave us three mantras to fulfill our aspiration:

1. Make a business case for the developer/builder team to adopt Green Building as their USP.
2. Make IGBC Chapters nation-wide, to be headed by a dedicated construction industry leader, who would lead the Regional Chapter within CII protocol.
3. Develop IGBC ratings democratically, for each specialized application of sustainable built environment.

And we followed JNG's advice to the hilt. Bharat's story is unparalleled amongst members of the World Green Building Councils (WGBC). We reached a billion sqft registered green footprint with IGBC in 2012, three years ahead of schedule, without hardly any incentive to adopt Green. We did not want subsidies, as money could lead to malpractice; it was achieved purely on voluntarily adoption because of the business case we had made.

Three decades of MEP designs which followed all the norms of IGBC—enhancing the health and well-being of occupants through IEQ control, highly energy efficient (under-writing low HLP), achieving maximum water conservation through recycling, and with negligible waste disposal from construction waste and waste during operation—gave us impeccable credentials to approach major builder/developer teams to adopt Green as their core value. We were successful in getting the Rakheja Group, Lodha Group, Hiranandani, and others in Mumbai; Prestige, Adarsh, Poorvankar and Sobha Builders from Karnataka; Ajit Chordia from Chennai; and Rahul Saraf from Kolkata, to make Green Buildings their USP for sale, even at the cost of marginal reduction of commercial gains. We had limited success with major builders in NCR, due to their earlier success with whatever they offered, and we could not argue with success. But with incentives provided by Uttar Pradesh

and Haryana State Govts to IGBC certified Green Buildings, we have finally converted some of the major players in these states.

And with the PMO's brilliant initiative of 100 Smart Cities, which MoUA accepted would be based on IGBC Green Cities (Existing) rating, our clock has not stopped ticking despite the temporary lull in the construction industry due to unreasonable prices in metros. Every month we add a few million sqft of registered green footprint, adding only 10% of built-up area of existing green cities for registration with IGBC.

Having founded ISHRAE from my home in 1980 with only a handful of members, now exceeding 20,000 members, and the ASHRAE India Chapter at large in 1989, bringing to Bharat the highest award of "Distinguished Fellowship ASHRAE", and teaching for 47 years at SPA New Delhi, gave me the track record for plunging head on for IGBC, to fulfill my *Junoon* of unconditional devotion for *Janani Janmabhoomi* Bharat. When friends at IGBC call me the *Bhishma Pitamah* of the Green Building Movement, my heart fills with gratitude. My devotion to Bharat is unconditional, and on the path of dharma, truth and justice.

In the evening of my life, through IGBC, I have discovered lifelong friends with whom I share the same values, each one leaving the stamp of their selfless dedication, and sharing their passion and commitment for the great cause. It gives me renewed strength every waking hour of this long beautiful life, which is filled with purpose. It has permitted me to touch hundreds of thousands of lives in one lifetime, to arouse their pride in our heritage and in our ancient wisdom. I will always remain grateful to IGBC for giving me this lifetime opportunity.

With 23 Chapters all across Bharat, each led by an eminent thought-leader, and 20 united ratings—one for each

specialized application, with many more in the pipeline, the sky is the limit for Bharat's global leadership in preserving all life on our Mother Earth. And a handful of us have been chosen out of the 1.3 billion to make our contribution on this glorious journey. We will collectively fulfill the prophecy of sages Sri Aurobindo, Sri Ram Krishna Paramhans, and Swami Vivekananda—that this is Bharat's century. We will again be Jagat Guru in worshipping Nature in all her glory and majesty.

PROFESSIONAL SOCIETIES PARTNER WITH IGBC

Joining the American Society of Heating Ventilating Engineers (ASHVE) in Minnesota in 1959, brought me in contact with the great American scholars and outstanding academicians in the profession. I was fascinated with their vast pool of experience, continued R & D, and by them contributing voluntarily to society. A few years later ASHVE merged with ASRE and was permanently christened the American Society of Heating and Refrigerating Engineers (ASHRAE). It was an elitist society full of scholars operating from their ivory towers.

Therefore, I founded ISHRAE from my home, with a handful of like-minded professionals, vendors, contractors, manufactures and users. Our mission was just! ISHRAE grew rapidly and we enrolled shop floor operators who have the finest experience beyond scholars. Today ISHRAE has 20,000 members, 8000 student members and 40 Chapters across the nation.

In 1989, I started ASHRAE India RAL from my home with 50 ASHRAE members. Today the Delhi Chapter has grown to 9 Chapters with several thousand ASHRAE India Members. Then in 1985, ASHRAE made me Fellow ASHRAE in its centenary year, and in 2007, awarded me

ASHRAE's highest honor of Distinguished Fellow, bringing the coveted honor to Bharat.

I have belonged to a host of professional societies for 40-50 years. I was able to prevail upon IIA, IID, IPA, FSAI, ISLE, and others to become partners with IGBC and share our best practices with professionals in all related fields.

NATIONAL BUILDING CODE OF INDIA (NBC), 2016

One of my more gratifying contributions to Indian Code and Standards has been authorship of the HVAC Section (Chapter 8 – Building Services) in NBC 2005. Fortunately, two of the leaders of NBC's first version in the 1970s are with us. Dr. Vishveshraya, despite his advancing years with not-so-good health in his late 80s, still Chairs the BIS committee CED, responsible for NBC. Vice-chairman V Suresh is now our chief statesman for IGBC, Chairing the Government Polices and Advocacy.

NBC in the 70s and mid 80s was drafted entirely by our brilliant and dedicated professionals from the CPWD, State PWDs, Indian Railways, MES and PSUs like ONGC, Indian Oil and NBCC. They had limited exposure to international developments since imports were discouraged and work was awarded to the lowest tenderer (L1). The first two versions of the NBC did not even mention ASHRAE in the HVAC section; instead, it had a vague mention of New York and Europe standards. Even the weather data for metros, tier two and tier three cities was from the US Air Force. Our Metrological Department recorded dry bulb and wet bulb temperature, RH, solar radiation, wind velocity and wind direction, rainfall, and dust levels in hand-written log-books.

ISHRAE took the lead in numerical data conversion from hand-written logs, and the WESDEC software program was developed for 60 odd major cities of Bharat.

Being the eldest member of the HVAC & R Industry, I am often lovingly called the Father of Air Conditioning in India. I had good rapport with the industry's best minds. They contributed their knowledge, experience, and shared the R & D work in their labs to help us rewrite the section on HVAC (Chapter 8) for NBC 2005. The new code was at par with the finest in the world, exploring the latest state-of-the-art technologies being used, and being developed in labs worldwide.

Codes have a maximum lifespan of 3-5 years, by when technology takes major leaps ahead. NBC, because of the sheer wealth of contributions by the nation's best professionals, has been revised every ten years so far. Leading IGBC for a sustainable built environment, I pleaded with the Chairman and Vice-chair of NBC, to introduce Chapter XI as an Addendum to NBC 2005, so that sustainability, which appears in many Chapters of NBC 2005, gets consolidated in one Chapter for the ease of adoption. Upon pursuing, I have been given the honor of authoring two sections– the section on HVAC (Chapter 8) and a new Chapter XI : Approach to Sustainability.

NBC 2016 consolidates sustainability in Chapter XI, and is easy to use by municipal authorities nationwide. They grant permission to construct a building by sanctioning building plans. The architect has to give an undertaking that the provisions of NBC 2016 have been incorporated or exceeded.

Unfortunately, the nation's wealth of knowledge and experience of 30 highly experienced authors of various parts of NBC 2016 is not made mandatory, only recommendatory, to avoid ills of malpractice during inspection. But all is not lost since the Chief Fire Officers all over the country follow or exceed the provisions of the NBC for fire safety. Municipal approval implies structural and life-safety provisions. These hold valid in our court of law in case of any unfortunate

incident with building construction, and NBC 2016 has been adopted throughout the country without any biases.

It is our hope that someday in the near future, Bharat will follow the example of many other nations and the Guidelines drawn up by NBC, ECBC, Ministry of Environment, Forest and Climate Change (MoEF), and CPCA norms, will become the law of the land, and will become the responsibility of architects, consultants, and PM/CMs, in all States of Bharat, with any omission being made punishable by our courts of law.

IN GRATITUDE

1. My Eminent Colleagues at GBC

My eminent colleagues at GBC Hyderabad nominated me in January 2007 to be the flag bearer of the Green Building Movement and of IGBC. This was a defining moment in my life when I was called upon to carry a huge responsibility for my country, and I discovered my calling. This life has been granted to me with such an honor to devote my time in serving my *Janani Janmabhoomi* Bharat, unconditionally, and with all my strength.

I have been fortunate to work closely with stalwarts of IGBC – SRP, Giri, Srini, M Raghu and Anand. Each one is a master in his field, working with humility, without any pomp or show or loud declarations. I learnt from them the finer nuances of certified Green Buildings, Bharat-centric design, and construction responsive to our own climatic zones, solar movement, wind direction, wind velocity, rainfall, daylight hours, and dust.

I will always remain grateful to each of them for patiently guiding me in my quest for learning.

Then came the second generation of young professionals—Sampath, Karthikeyan, Ritabrata, Punit, Rekha, Saurav, Pallavi, Animesh, Himashu, Naveen and Praveen—all in their prime of youth. They have decided to build their careers in IGBC, despite far better opportunities that could help them with greater financial security for their families. That would have come with a Do-or-Die, or Fly-by-Night career, with emphasis only on profit and loss, not on service.

I salute each of the beautiful family members of IGBC, who have preferred a career in service to Bharat, rather than pursue small commercial gains. I am also grateful to each

of them for bearing with my lack of patience, and mild reprimands in a fatherly role when something did not get concluded for a long time, due to no fault or lack of follow-up on their part.

This is the other side of democracy wherein 3 RURBAN Secretaries of MoUA could not endorse our Green Village Rating for Villages and RURBAN areas, as a pre-requisite for giving subsidized land to the developer; or when four VCs of DDA could not endorse incentives for projects in Delhi for IGBC certified Green Buildings over five years. Fortunately, we have our Chairman Advocacy and Government Policy, V Suresh—Our Chief Statesman, and we are confident these and other issues will soon be concluded.

Friends, Philosophers and Guides

A few friends, philosophers and guides during my beautiful journey on the Path of Green, are V Suresh, our Chief Statesman whose passion and commitment to IGBC is legendary; Sharukh Mistry–the Frank Lloyd Wright of Bharat, ever ready to move to rebuild the lives of people worst affected by natural disasters such as tsunami in the south, the earthquake in Bhuj, the earthquake in Nepal; Syed Beary who develops only IGBC Platinum Green Buildings around existing fully grown trees, and offers free education to children from his ancestral village; Hari the journalist, the creator of Z Homes with zero energy and zero water consumption for elite living quarters, at modest prices, whose black box gives us free access to global leading thinkers of sustainability; Jaimni who single handedly got the Rajasthan Government to adopt IGBC green schools, green villages, green healthcare, and got us fabulous incentives for IGBC certified Green Buildings throughout the State of Rajasthan; and will now convert the four Smart Cities to IGBC Green

Existing Cities, in Rajasthan; Jit Kumar Gupta, the highly respected town planner and academician, who quietly got the incentive for IGBC certified Green Buildings in the State of Punjab and Himachal Pradesh; Sameer Gupta, our young and charismatic Chairman, UP State Chapter for Bharat's largest state giving 5% incentive for IGBC certified Green Buildings; Padma Shri architect Raghavendra Rao who developed LEED for India's commercial and institutional buildings with USGBC's reluctant consent to make it Bharat-centric; Gurmit Singh, our General of the green brigade in Bharat's commercial capital Mumbai; Chief of Bharat's major Corporates, Thyag, President of Blue Star; Kanwaljeet Jawa, MD Daikin India (first Indian on Board of Daikin), the world leader in unitary air conditioning systems; Arun Bhatia, the young President of Carrier India; Gopi, the Leader of Voltas from the House of Tatas; and Srikant Bapat, the dynamic MD of Johnson Control India, a world leader in IBMS and central air conditioning.

They have each held my hand, showed me the way to concentrate my energy, kept the flame burning in my heart for my magnificent obsession, and indulged me in my fancies. I can never be grateful enough to each of them for the generous sharing of their individual expertise to make IGBC a true national movement that is all-inclusive.

Of special mention is my idol Kamal Meattle, who has perfected IEQ control through the use of ancient Ayurvedic principles. He provides IEQ of Gulmarg in the heart of the world's most polluted city Delhi, and was invited to TED Washington to talk on how to grow fresh air. Fortunately, his prodigy Barun Agarwal has converted his vision to user-friendly electric and electronic module for homes, offices, schools and others, reproducing the finest IEQ without the problem of maintaining hundreds of plants on a regular basis.

I must also mention my friend Ajay Poddar, who has developed inexpensive room-based modules to minimize the harmful effects of today's daily necessity—mobile phones, and the earth's electromagnetic radiation. Fortunately, his young son Manav has commercialized his vision for hospitals, offices homes and other applications.

Gurus for IGBC and Well-wishers from Overseas

We are fortunate that three of Bharat's foremost institutions and their Chiefs of Sustainability have given whole-hearted support for R & D with local materials, setting up of labs for the testing of indigenous civil construction materials, and quantifying the magic of our ancient wisdom. They are :

Dr. Jyotirmay Mathur, Dean and Head of Sustainability at Bharat's first Platinum rated MNIT Jaipur; Dean and Head of Sustainability, Dr. Vishal Garg of IIIT Hyderabad; and Rajan Rawal, Head of Sustainability at Bharat's premier institute CEPT Ahmedabad, that has a fully equipped test lab for the assembled face of registered Green Buildings.

We have IGBC friends from overseas: Dr. Kath Williams from USA, our Guru in guiding us to attain the world's highest Platinum award for GBC Hyderabad. She considers Bharat to be her second home.

Nakano San, Chairman Daikin Asia, who gave us Bharat Ka Daikin with inverter technology, the world's most efficient split unit at Rs. 30,000/TR, available only in Bharat, its low operating cost makes it affordable for MIG and even high LIG groups of Bharat's citizens.

Ms Megan Lehtonen, Ex chief IAPMO for Bharat, who gave us testing and rating for indigenously manufactured Low Flow fixtures, resulting in huge water conservation, and also conducted training courses for plumbers in green plumbing,

now used by IPA and the Plumbing Skill Development Council across villages and urban areas of Bharat.

Major Developers and Manufacturers

The reach of IGBC amongst developers and builders has vastly increased. Amongst the biggest contributors to IGBC awareness are our green champions–IGBC's own Sameer Sinha, MD Saavy Infrastructure, Ahmedabad; Ajit Chordia of Chennai Chapter; Rahul Saraf of Kolkata Chapter; Ravi Raheja, Abhishek Lodha with Tikam Jain, Niranjan Hiranandani – premier developers of Bharat who talk the language of builders and developers on how their bottom line has considerably improved through the patronage of IGBC as their USP.

Similarly, the major manufactures who have done amazing R & D work in their labs to manufacture Green Co-certified indigenous products, are Mahesh Anand of Nippon Paints for Low VOC and No VOC paints; Sanjay Kirloskar, Chairman Kirloskar Pumps with the highest efficiency, fail-safe fire pumps at affordable prices; Shirish Adi, MD Emerson Technology India for a variety of refrigeration compressors with exceptionally low IPLV, and RK Somany, Chairman HSIL for indigenous Green Co- certified Low Flow Fixtures, dual flushing waterless urinals under the Hindware patent, thereby bringing Hindustan to the world stage.

Major Public Sector Undertakings (PSUs)

The first and major PSU patronizing IGBC and developing the world's first IGBC Green MRTS Rating, is DMRC, led by Dr. Mangu Singh, MD; AK Gupta, DG electrical; our eminent EC member, and AK Singh, Chief of Planning

Metro Facilities all over, with their new and existing Metro Stations to be the role model, with IGBC's highest Platinum Rating; CMD Alok Sharma of DMIC ensuring new and existing major projects like Dholera avail IGBC pro-bono service to make them Green rated; NBCC CMD Dr Anoop Kumar Mittal, for adopting dual rating including IGBC's Green certification for Bharat's major developments like ITPO, Kidwai Nagar, and Sarojini Nagar in Delhi, WTC in Guwahati, Noida's tallest building WTC in NCR, Conventional Complex Dwarka and many more; CPWD DG and President IBC Abhay Sinha for incorporating dual rating with IGBC in their revised specifications and guidelines for Bharat's largest number of Government buildings, including special rates in the Schedule of Rates for Green products; CMD IRSDC Mr S K Lohia for redevelopment of Railway Stations across the country; Shri Sanjay Pant of BIS for introducing new Chapter XI in NBC 2016 on Approach to Sustainability, stating that Municipal sanctions of Plans implies adoption of Green Building Guidelines so that Green becomes the way of life; Dr. Chandra Shekhar, Ex Chief Architect, Ministry of Health and Family Welfare, GOI, for authoring IGBC Green Healthcare Facilities, and so helping Bharat's citizens at the bottom of the social pyramid to get the finest medical care offered by the Ministry.

My Fellow-Consultants and Architects

They are dedicating their experience and influence to construct buildings in harmony with Nature, even without IGBC rating. They are the first contact for MNCs opening office in Bharat and for project promoters. Their awareness and commitment to Green Buildings helps owners to construct Green Buildings. With decades of teaching experience at SPA, New Delhi, and running Spectral for

more than thirty years, my path has crossed many second generations of architects and brilliant students. I owe them gratitude for carrying the tradition of our great masters to build in harmony with Nature. Best known to me and by whom I have been inspired, are:

Dr. Ashok Lall; Dr. Vinod Gupta; Nimish Patel; Parul Zhaveri; Rajiv Kathpalia; Vimal Patel; Karan Grover; Ashok Mokha; Sandeep Shikhre; Kiran Kapadia; Prem Nath; Shekhar Patkie; Shrukh Mistry—Frank Lloyd Wright of Bharat; Mala Singh; Poorva Keskar; Shakuntala Ghosh; B R Ajit; Sheetal Rakheja; Vidur Bhardwaj; Manit and Sonali Bastogi; Abhimanyu Dalal; Sonali Bhagwati; Jasbir Sawhney and Dinesh Sareen.

Premier consultants dedicating their experience to IGBC, with whom I have worked closely are:

Ashish Rakheja, Chitranjan Kaushik; Rakesh Bhatia; Rajat Malhotra; Pankaj Dharkar, and Anuj Aggarwal of ICICI bank.

My Comrades-in -Arms

Amongst other Chapter Chair and Co-Chair, beyond those mentioned above, I have been most inspired by the dedication and commitment of my other comrades-in-arms, for whom I can never be grateful enough, for keeping the fire of my passion burning. They are:

Sameer Sinha; Jayesh Hariyani; Vijaya Sai; Jit Kumar Gupta; Arun Bhatia; Bharat Kamath; Shekhar Reddy, Abhaya Shankar; Soma Shekhar; Sri Ram; JP Shroff; Leela Prashad; Sameer Gupta, and Sachin Sharma.

Life is Immensely Beautiful

Those whom I have welcomed with great honor and eagerness
Will vanish and merge into darkness.
He I ignored, did not know, did not understand –
His face will appear again before my sleepless eyes
In the light of the stars, in the perfume of rajanigandha
His many departures will echo in my heart as many returns

I am like the twilight dusk lost in meditation,
Gazing at the earth.
In front of me stretches the endless plain.
Thou art like a Piyal Tree
Standing solitary on the horizon.
And spreading thy branches over me.
My silent heart
Lost in the touch of thy Green,

Forgets the sun, moon and stars.
Thy leaves – Like fingers, graceful and tremulous –
Long for the kiss of light,
For the passion of evening glow;
Long for the whispering of stars,
For the limitless that is in the heart of me.

I had gone a-begging from door to door,
When thy golden chariot appeared.
Thy chariot stopped and thou came down with a smile.
Thou held out thy right hand and asked
'What hast thou to give to me?'
From my wallet I slowly took out the
Least little grain of corn and gave it to thee.
But how great my surprise when at the end of the day
I emptied my bag to find a least little grain of gold
Amongst the poor heap.
I bitterly wept and wished that I had had the heart to
Give thee my all.

Like the meeting of sea gulls and sea waves
We meet and come near!
The waves roll off, the sea gulls depart
And we part.

She whispered in the ears of the parting traveller
Her last gift, tremulous with love.
I shall forget thee not.
The traveller on the open road knows
He who goes, goes for ever
Those who remain behind, they seek new friends
They forget him, who has gone,

—From the writings of Tagore

I COUNT MY BLESSINGS AND STAY INSPIRED

Friends often ask me how I stay inspired, day after day, year after year. The simple truth is that I count my blessings for having been given this immensely beautiful life, full of love, purpose and meaning.

My small little world has only seven of us, out of 7 Billion people who enjoy the bounties of the planet we live in. Each day for us brings new hope, new joy and new purpose. Sorrows do come, health problems do arise, but we know how to face these and come out unscathed.

Ma, My Guru

My mother, my guru, whom I worshiped, lived in our home in Delhi. Stein's office was in New Delhi. My late hours forced me to move to a rented accommodation near the office. After my father passed away in 1973, Ma was left alone in a hostile environment. We spent weekends with Ma in Old Delhi but came back with a heavy heart on Sunday evenings to our rented house in New Delhi. The only luxury Ma enjoyed was that she was living in her own house which was almost a haveli. No amount of pleading would make her move in with us in a rented two-bedroom apartment.

Even a good salary at Stein's office was not enough to build our own house in New Delhi; hence I resigned from another comfortable and satisfying job. We pooled all our savings, borrowed heavily from LIC and banks, and built our own home in GK-II in 1980. Ma finally moved in with us and we lived with her in our own new home. Ma's presence made our home a temple. Whatever began from our home flourished beyond our wildest imagination.

The center of my universe is Ma–my Guru, who lives in my heart, enlightening my days and nights in my life's

journey. Her teachings were simple, which have been the Guru-mantra for me:

Only the best (The Number One) counts.

Education is the only means for success.

Truth Always Wins, no matter how difficult the circumstances.

Always aim for the stars, through hard work you will get there.

Let idle talk or negative comments not distract you from fulfilling your aspiration.

A Wise person is like a fruit-laden tree; more the fruits, lower it bends – Humility is virtue.

Righteous living is Reward in itself.

As the years rolled on, I added a few more of my own, based on my reading of the scriptures, living in Banaras and through my exposures :

Possess only what we need: Aparigraha. My worldly possessions for my daily needs fills only two large boxes.

Give generously and whole-heartedly with no expectation, knowing that the recipient will never be able to pay back. We are only the catalyst; the true giver is the Divine. We would then hold the Akhshay Patra (of Draupadi) which always remains full.

Share my learnings, my experience of decades with young leaders of tomorrow. Show them the path to the immense beauty of the subject, which would help them to explore specific solutions to each problem. No one solution fits all. My long innings of 47 years at SPA, New Delhi, is testimony to my commitment.

Speak the truth and only the truth, no matter how difficult the circumstances.

Selfless service to fellow citizens is the noblest religion.

The path of dharma, truth and justice always leads to fulfillment, no matter how ruthless and oppressive the opposing forces.

Follow Kshmavani of the Jain tradition. This encourages us to beg forgiveness from one and all for any hurt or offense caused by deed or thought.

Renu, My Soulmate Of Many A Birth

During my first visit home from USA, I discovered Renu. She lived across the street but I did not know her. All these years including those in Australia and USA, I had considered ladies as the avtaar of Shakti. They were mother or sister or daughter for me–with never any vikaar. Renu was dressed in a white saree, her long dark hair falling to her knees, her room was full of her paintings; ghungroos sat on the stand. She was the perfect embodiment of Saraswati. For the first time in thirty years, love sprang in my heart. I felt what Buddha had on his first glance at Yashodara.

Renu is beautiful, from a wealthy family from Multan. She was the Kathak Queen at Delhi University, a student of the fashionable Miranda House, studying M.A. in English literature. There were many marriage offers from the rich and mighty for her but she had declined, telling her parents that she would only marry me. No amount of cajoling or warnings could change her mind. Yet I came back without their consent, due to the terrible treatment of Ma by my elder brother's wife. But then my little sister and younger brother kept bringing Renu to our home in my absence. Renu's selfless service to Ma made things easier and Ma gave her blessings to Renu. Our three year-long courtship through letters lasted till October 1965, when I again came home for a week. We were married on 3rd October, 1965

and my younger brother arranged the nearly impossible US visa, marriage certificate and passport endorsement in 5 days. We flew back to USA together. My dear friend Anand (From BENCO) welcomed us in our new home in the USA.

Renu became the ringleader for a small group of Indian students and professors' families, organizing music and dance festivals on campus; she studied for a Diploma in Interior Design and Decoration on the University Campus, managed the household, and became my companion for my Ph.D. thesis on Computer Programming. I completed my Ph.D. Summa-Cum-Laude with straight A grades, and defended my thesis before an external Jury in 1967.

The next week, Movers arrived, packed our belongings, and without any interview, I became the Senior Research Engineer at the world's leading Carrier Corporation RDC, working with R & D in east Syracuse. Working with Carrier RDC's brilliant engineers and scientists was a deeply satisfying experience. Renu organized many music and dance evenings with the families of the engineers working with Xerox, GE, and life was a saga of happiness.

Then the call came from my little sister back home, about the failing health of my father and the trauma Ma was being subjected to by my brother's wife. Without a second thought I resigned, and Renu gladly accepted to move out of our comfort zone to an unknown future, to serve my parents.

Payal arrived on 5th May 1971; I got the position of Chief MEP Engineer at the office of Bharat's eminent architect Joseph Allen Stein, in New Delhi. The long hours of work forced us to move to a rented apartment in New Delhi, close to my office. Renu took up sitar as full-time profession in 1972. Due to a late start with the sitar, her sadhana was intense, spanning twelve hours or more each day, day in and day out, with baby Payal on her lap.

It is a great blessing that our home has always been filled with sounds of music—the *sapt swaras*. Every morning I have woken up to her melodies, for all these fifty years.

Renu's first concert was at Max Muller Bhawan, New Delhi. She got a standing ovation for her soulful performance. This was the first step in her journey of a thousand miles in the sublime world of Indian classical music. She has played the sitar for hundreds of music festivals and institutions that needed financial support. She has performed at the International Congress in all parts of the world–Atlanta, Washington DC, California, Dublin, Lisbon, Oxford, Cambridge, Muscat, Dubai, Singapore and others. She has performed for street children, battered women, destitutes, and monasteries, travelling on her own, not charging a penny, donating the entire collection to the organization. Her performances have all been for Saraswati Pooja. Our home is filled with awards given by institutions and music festivals world-wide, and she has the blessings of countless recipients.

I have attended only a few of her concerts in Bharat and have been mesmerized by her enchanting music. The images conjured in my mind have given birth to my writing small stories to interpret Ragas for the uninitiated. In December 1989 at the Birla Auditorium, she played Raag Megh to highly discerning Bengali music lovers, and my little write-up inspired by the raag is presented below:

Raag Megh

Month after month has passed but there is no rain. The horizon is barren. There is not a trace of cloud for miles. It does not seem that the monsoon will ever come or will bring the rains. The intense dry heat of summer has brought havoc to all living beings.

Long rows of tall deodar trees stand like mendicants, stretching their arms towards Heavens, begging: "O Lord! Take back this drought and the intense heat! Give us the monsoon clouds and the rains– wash anew this creation of yours!" But their prayers are not answered.

Quietly comes dusk. The sting has gone out of the rays of the sun. The sun is setting behind mango groves. Tired pupils have returned to the ashram after grazing their cows the whole day in the wilderness. They have washed themselves and sit at the feet of their Guru for the evening prayer. Guru Surdas is seated deep in meditation.

After ages, Surdas has thought of the veena. He tunes it to the five notes of *shadaj, rishabh, madhyam, pancham* and *komal nishaad*. These notes pass through the pupils like lightning–and a new hope is born in their hearts. Maybe today?

Surdas's eyes are closed. Pictures are emerging in his mind, pictures of thick black clouds of monsoon, the smiling form of Indra, the Rain-God. His breath is fragrant with the freshness of new rain. The pure notes of the veena rise and wane, the melody reaches a crescendo.

Suddenly the miracle happens. Yonder in the distance echoes the thunder. Thick black clouds of monsoon, laden with rain, come rolling in from all sides and cover the sky from end to end. Lightning strikes across the sky, sounds of thunder and the echoes merge with the rising notes of the veena. Tears are flowing from Surdas's closed eyes and incessant rain is falling outside. The parched earth quenches her thirst and a soft fragrance rises to the sky as if millions of grains of Mother Earth are sending thanks to the heavens above.

It is thus that Raag Megh heralds the rains.

Payal, More Precious Than Life

Before joining architect Stein's office in New Delhi, Renu and I went on a Bharat Darshan. We went to every ancient and modern temple and church in the southern cities and towns, praying for a little girl. It was a difficult journey by trains and buses without any previous reservations, but we were determined. Our last stop was Gomateshwar near Bangalore. When we prayed at the feet of Lord Bahubali (the world's largest monolithic statue carved out of a mountain), we both knew that our prayers would be answered. We had only prayed for a little girl, and the universe put in our laps its rarest and most precious gem.

Payal came to our home on 5th May, 1971. I still remember how overwhelmed I felt when I first held her in my lap. She was the world's most beautiful soul who belonged to all and had become ours. I whispered in her ears her first words in this life –Buddha's blessings. 'May the eternal bliss be yours my child, and life's burdens sit lightly on your shoulders.' And heaven descended upon our home. Life has never been the same again; our thoughts, our daily prayers, our days and nights, since that day, are all centered around her happiness.

Payal has inherited in its fullest measure Renu's beauty and creativity, love for art and music and my deep faith in righteous living, humility, and abiding love and kindness for all. We are blessed that since her birth, Renu has pursued *Saraswati Sadhana* with Payal in her lap, and my professional career blossomed to its fullest glory. Payal's presence also encouraged me to always speak the Truth, no matter how difficult it may be in some circumstances.

Upon completing B.Com honors from Delhi University, she chose to become a Fashion Designer. She went to FIDM, San Francisco, which is amongst the world's most eminent

institutions, graduated Summa-Cum-Laude with straight As and was on the President's honor roll. She returned home in the early 90s to start her own couture label 'Payal Jain' in New Delhi. I still remember with great pride, her first fashion show in December 1993, in New Delhi.

Payal had invited super models from Mumbai like Arjun Rampal, Sushmita Sen, Aishwarya Rai and others. These are people known for their perfect bodies and unmatched beauty. She had also invited and made dresses for forty differently-abled children, some with badly deformed bodies, and others with mental development of a five or six-year-old. They were brought one-by-one on the ramp with lilting music in the background. Differently-abled children in those times were kept cloistered, and led a solitary and miserable life due to the stigma attached to mental and physical disabilities.

Over one thousand Who's Who of Delhi were our guests; many of them were parents of the children walking the ramp. And then the miracle happened! Instead of walking with the child holding his/her hand, each model lifted the child on to his/her lap and walked the full length of the ramp to a standing ovation and loud applause. The show went on for an hour; not one person sat down, nor did anyone cease shedding tears of joy from the experience of such profound love and human kindness, which was despite the lack of looks or physical beauty. At the end of the show, not a single model took any money, experiencing for the first time in their career, that they had given true happiness to a special child, and enriched their souls, which no money could buy.

Payal's maiden show had an ethereal beauty, almost magical, which transformed these children's lives. The little ones, who had never met outsiders, were suddenly in the laps of beautiful models; they saw, for the first time, a sea of humanity, all standing, clapping, smiling and shedding tears for the child's brave front. It dawned upon the children that

they were being admired for their strength, and not shunned for deformity. The weeping parents saw the wonder in their children's eyes and knew that henceforth their children would go through their days learning new things at school and mixing with peers, feeling equal.

Such a show has never been, shall never be again. It was like Satyajit Ray's *Pather Panchali*. These remain the creator's masterpiece.

The entire princely sum collected from the sponsors was spent in building the Tamana School for Special Children in New Delhi. Ever since then, for over 25 years, Payal has done similar fashion shows for the Tamana School, for street children, for battered women, for destitute women and children, for orphanages, and for cancer patients, and in return she has earned their gratitude and blessings.

No act of kindness is ever wasted. She has risen to the top of the Indian fashion industry, dressing women from all over the world with Indian handlooms and textiles, designing uniforms for corporates and hospitality groups including the Leela, the Taj, the Oberoi, the Hyatt, and the Shangri-La. Her couture designs are marketed in Australia, Europe, the Middle East, South East Asia and USA under her label 'Payal Jain'.

Payal's mere presence inspires me to lead a righteous life, living on the path of dharma, truth, justice and humility. I have generously given my learnings and much of my earnings for the education of those who are not privileged in this life, to help them go for the best education.

My life of Aparigraha helped me fulfill my mission.

Bharat has an amazing Guru-shishya Parampara. The guru shows the way and the shishya has to traverse the journey. But the greatest joy for a guru is always when his shishya goes far beyond him. Payal has inherited all my values and taken these to a much higher level with compassion, affection,

generosity and sisterly love for all those less privileged, whose path crossed hers. This is the source of my staying inspired.

We have all heard the saying that a son is till he has a wife, but a daughter is for life. Who will know this better than me, to be the absolute truth in simple words? After 80 plus years of sound health, I have had many medical challenges in the last one year. Payal has stood by me like a rock, forsaking her own family; all her thoughts, and concerns have been for my recovery. With such abundant love, sickness cannot last. I am confident I will be my old self –strong and determined, in the next few weeks.

My Little World Of Manish, Jai And Yash

In the later part of 1998, Payal brought home Manish, who asked our permission to marry her. I could never imagine that this handsome young man, owner of a flourishing travel business, did not gamble, did not drink, and did not even smoke. Even if we went out to search for someone like him with a lamp in our hands, we probably could never have found one. Therefore, our consent was spontaneous and instantaneous, and we embraced him.

Payal and Manish got married on Christmas Day,1998. Theirs was the most beautiful wedding at Jag Mandir in Udaipur. Shreeji ensured that the wedding was in Royal tradition. We ourselves were more like wedding guests.

On 29th January, 2000, the universe granted us the noblest gift of Jai and Yash, our beautiful twin grandchildren. They are brilliant, healthy, and love sports – inherited from Manish. Renu and I have given them the finest sanskaars, which would enlighten their life's journey. My greatest joy is that Payal's twin boys are following in her tradition of philanthropy, abiding kindness and deep religious faith.

They graduated from Singapore American School with top grades and are proceeding to USA for undergraduate studies in Liberal Arts in colleges of their choice, amongst the best in the world for Humanities.

With Manish as my son by Love, not by birth, and Jai and Yash following the path shown by Payal, I always stay inspired. And our lives are bliss.

Crystal Gazing – Bharat of My Dreams

Where the mind is without fear
And the head is held high;
Where knowledge is free;
Where the world has not been broken up into
Fragments by narrow domestic walls;
Where words come out from the depth of truth;
Where tireless striving stretches its arms towards perfection;
Where the clear stream of reason has not lost its way
Into the dreary desert sand of dead habit;
Where the mind is led forward by thee
Into ever widening thought and action.
Into that heaven of freedom, my father,
Let my country awake!

—Gitanjali, Tagore

Bharat Shall Provide Free Basic Education And Skills Training

Every child would get free basic education and free skill training as per his/her aptitude. This would help them provide for food and clothing. Green homes as per IGBC norms, would be provided as per their basic needs. No child would go hungry or beg because of lack of skill training.

Bharat Shall Have No Reservations

A gravely ill and dying Prime Minister set Bharat back by a hundred years through Mandal Commission. He introduced reservations for education and Government employment on the basis of caste. It spread like wildfire, providing reservation for minority well-to-do-communities. Some states today provide 50% or more reservation, bringing down opportunities for bright youngsters. Consequently, the least deserving get selected, bringing down the higher education level and skill required for professionals; Government engineers, doctors, even the judiciary. This must and will end, hopefully bringing us at par with the rest of the developed world.

Bharat Will Be Jagat Guru For Adhyatmic (spiritual) And Vedic (well-being) Studies

One thousand five hundred years ago, Nalanda University was founded in Bihar on the Buddhist Pilgrimage route. Scholars from near East, Far East and Asia Pacific, as far away as Japan, came to study Buddha's preachings scripted in Prakrit, and later in Sanskrit, to take the message of universal truth and peace to the whole world.

Such institutions would come up in Bihar/UP and in Andhra Pradesh/Tamil Nadu, where ancient heritage has been preserved for centuries.

Healthcare For All By The State

It is the universal truth that what is born would die. Therefore, at some stage healthcare is essential to minimize physical suffering. Government initiatives or 'Ayushman Bharat Yojna' would ensure primary health care in the region, secondary healthcare in a cluster, and tertiary healthcare at the State level. This would ensure need-based healthcare availability to all. Affluent members would not need this support as medical care facilities would be available at private hospitals and well-being centers.

We Will Be A Federal Republic Democracy

There would only be two political parties as in many western nations. Politicians would rise to service before self. Simultaneous elections for Centre and States would ensure that national interest prevails above narrow domestic interest. Efforts have already started to make it a reality in the foreseeable future.

Fair Implementation Of Policy

'Hum Do Hamarey Do' to be implemented through multimedia and incentives, not by coercion.

Similarly, heinous crimes like murder and rape would be punished by death, without any political debate or pardon, to eliminate these altogether.

Services would be financially well rewarded to root out corruption. Despite that, if found guilty, the corrupt person would be suitably punished without wasting judiciary time.

There would be affordable housing for all. There will be no EWS. LIG housing would be subsidized by the State. HIG and MIG would be by individuals as per their affordability, to construct and operate as per IGBC Green norms.

With no waste generation, rivers would be holy and clean and all life forms would thrive once again.

Prophecy Of Sages

Sri Aurobindo and Swami Vivekananda had prophesied that 21st century would be Bharat's. Tagore in *Gitanjali* foresaw a Bharat where this would come true.

I know in my heart that Bharat will be *Jagat Guru* again!

I stand before the creator and beg for one wish
That I be born again in Bharat,
To serve my Janani Janmabhoomi
And fulfill my dream of
Bharat again becoming the Seat of Learning for
Aadhyatmic and Yogic studies.
Scholars from all over the world will come to Bharat,
to take with them and spread the message of Universal Peace and love,
in our troubled world of today.

—Prem Jain

In the twilight of my dim consciousness
I see my body float by in the dark stream
Carrying her gatherings of feeling,
Suffering and Remembrances.
As she moves from the far to the far distant,
Her form fades; the evening bells die out
Along the banks where the shadows fall,
From house to house the doors close
Hiding the evening lamps:
And the night thickens – silent is the forest.
With the hushed song of the bird
The universe offers itself in self-dedication
At the feet of the great silence.

—Rabindranath Tagore

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