

CAMPUS ON THE SABARMATI

IIT GANDHINAGAR



**INNOVATIONS
AND CHALLENGES**
CONSTRUCTION OF A NEW CAMPUS

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Note:

Some of the text as well as the figures draw from other publications in the series, Campus on the Sabarmati. This text was originally prepared by the various architects and landscape architects working on different components of campus development. More recent material summarising innovations and challenges has been prepared by the authors. It is hoped that this publication will be of interest to design professionals as well as others interested in campus planning and development, and that it will also serve as a useful educational tool for students and young professionals.

ILLUSTRATIONS/ PHOTO CREDITS

Gaurav Shukla, Devarsh Barbhaya, Mitimitra Consultants Pvt Ltd,
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LAYOUT

Gaurav Shukla

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FOREWORD

Once created, universities may last not just decades, but centuries. Hence, it is a rare privilege for anyone to participate in the process of creating a new university. Establishment of the Indian Institute of Technology Gandhinagar (IITGN) has enabled all of us associated with the Institute to innovate in creating curricula, organising governance, and nurturing a unique culture and ethos of the Institute. The philosophy of education has been to push traditional boundaries with an emphasis on multi-disciplinary approaches and crosscutting thematic areas.

Just as the Institute endeavours to think out of the box for its academic programmes and governance, it has also been doing so for development of its 399-acre campus on the banks of the Sabarmati River. It is our firm belief that the physical environment makes a huge contribution to shape the processes of learning and knowledge creation. The campus has been conceptualized keeping in mind the long-term objectives as well as the present needs and immediate future. The guiding principles of the campus development have been

- An ambience that attracts visitors and conveys to them that they are on a university campus unlike any they have visited before.
- Functional convenience for the academic community for mutual interaction, learning and research.
- Low energy and resource consumption, as well as minimal upkeep and low maintenance costs.

The engagement of a large number of professionals and academics in brainstorming and in executing the design and construction has enabled us to introduce numerous innovations in the development of the campus. This publication is one in a series that explains the complex decision making, design, and construction process for the new campus. The publications in this series have been made possible because of several visits of Ms Marjorie Greene to IITGN as a Scholar-in-Residence. She worked to systematically compile the various materials presented here, collaborating with IITGN colleagues as well as our architects and consultants.

ABOUT THIS PUBLICATION: This publication highlights some of the innovations and challenges that faced campus developers during the first phase of construction. Some of the materials have been taken from publications prepared by the various architects and other consultants who worked on components of the campus. Materials have also been provided by some of the key participants in campus development, including the Owner's Architect, the green waste consultant, the Institute Works Department and a faculty coordinator for the NYASA programme.

Sudhir K Jain
Director and Professor
Indian Institute of Technology Gandhinagar

EXECUTIVE SUMMARY

This publication provides an overview of the major innovations that were introduced and challenges that were faced in the construction of Phase IA of the new campus of the Indian Institute of Technology Gandhinagar. Innovations in the physical development of the campus can be generally divided into seven main areas, which form the chapters in the publication.

Understanding the Physical Planning Fundamentals

The academic mission and its emphasis on out-of-the-box thinking shaped the physical development of the campus. There were significant site constraints that dictated the overall shape of the campus and its layout considerations. The master planners used these constraints, particularly the ravines and the resulting small amount of acreage available for the built-up area, to give a unique identity to IITGN. This unique identity includes features such as the Scenic Drive and the Central Vista.

Planning and Managing a Complex Construction Project

From the beginning the Institute developed a participatory process that engaged all the major stakeholders in campus development. One unique feature of development was the decision to use multiple architectural firms for different components of the campus, all guided by principles specified by the master planners. Project execution was the responsibility of the Central Public Works Department (CPWD) of the Government of India and they worked alongside Institute leaders as partners in campus development.

Living in a Harsh Climate

Recognising the very hot climate in this part of India, the master planners and architects used a number of techniques to increase cooling and reduce heat gain. These included design features and architectural elements as well as a Passive Downdraft Evaporative Cooling technique. The experience of one academic building, Building 7 and hostel mess, where a range of cooling techniques were implemented, is described in more detail.

Using Water as a Core Element

One of the guiding principles for campus development was to preserve the natural water bodies and landscape as well as to use water features extensively throughout the campus. Not just a visual element, water is also used as a cooling agent. All the water bodies are part of the water management system. Strategies for water harvesting and conservation are also integral to campus development.

Designing a Green Campus

The Institute has taken the progressive step to segregate and manage all solid waste, with an ultimate goal of generating zero waste for landfill. This requires the reduction and segregation of waste at the source. A robust infrastructure has been developed for solid waste management. Diverting waste from the landfill requires a significant educational shift on the part of the entire campus community. Constant reminders of the need to reduce and segregate waste exist throughout the campus, through initiatives to use only reusable materials (water bottles, tea glasses, plates, etc) as well as posters and the color-coding of bins. Additional green initiatives include zero sewage discharge, initiatives to reduce car usage on campus, and the use of solar power.

Promoting Ownership in the Campus

IITGN's design as a residential campus is one of its core features. All students are expected to live in the hostels, and 80% of the faculty and 50% of the staff live in the housing blocks. Closer academic and social interaction between students and faculty and staff is possible because they are living close together. In addition, the campus has multiple spaces that have been designed to encourage formal and informal gatherings and social interaction. A stronger community spirit results from this wide variety of exchanges.

Fostering Social Responsibility

Beginning with the location of the temporary IITGN campus and the construction of some temporary buildings to use for offices and classrooms, the Institute acknowledged their responsibility to improve the working and living conditions of construction workers and their families. An educational engagement programme, NYASA, was developed with the enthusiastic participation of student and staff IITGN volunteers.

ACKNOWLEDGEMENTS

IITGN would like to acknowledge all the contributions of various stakeholders in the construction of the IITGN permanent campus. This includes the students, faculty and staff who were actively engaged in the process of defining the character and look of the campus, as well as all the architectural firms, consultants and subconsultants, the Central Public Works Department (CPWD) engineers, contractors and the construction workers.

Special appreciation must be given to the contributions of Prof Ashwini Kumar, Visiting Professor, Civil Engineering; Prof Amit Prashant, Dean, Academic Affairs (from 28-10-2012 to 7-01-2018); Mr Nagaraja Billur, Advisor, Works Department (from 23-04-2012 to 30-04-2013); Mr Anil Kothari, Superintending Engineer (from 05-08-2011 to 28-01-2013); and Mr G C Chaudhary, Superintending Engineer (from 04-02-2014) from IITGN and Mr Kapil Deo Narayan, Project Manager, CPWD (from 29-01-2016 to 09-01-2019). The entire CPWD team was critical to the success of the construction of Phase IA of the campus.

IITGN would like to acknowledge the exemplary leadership and visionary spirit of the M/s Green Campus Development Consortium, in particular the project leader Dr Vinod Gupta, the urban designer Ar Ujan Ghosh and the landscape designer the late Prof Mohammad Shaheer. Their imaginative vision for what the IITGN campus could be, and their ability to translate this vision into the master planning framework has guided all aspects of campus development.

The architects for the various components of Phase IA of campus development played critical roles in defining the distinctive character of the campus during the first phase of construction. They include M/s Mitimitra Consultants Ltd. Pvt, under the leadership of Ar Madhav Hundekar and Ar Vikram Hundekar; M/s Vatsu Shilpa Consultants, under the leadership of Ar Rajeev Kathpalia and Ar Sönke Hoof; M/s HCP Design, Planning and Management Pvt. Ltd, under the leadership of Ar Bobby Desai; and MSYK Design under the leadership of Late Mohammad Shaheer and Mr Yogesh Kapoor. In addition, the contributions of all the various consultants and subconsultants necessary for such a complex construction project are most appreciated.

Ms. Nupur Tandon representing M/s Pro Waste Concepts Pvt. Ltd. has been the Solid Waste Consultant and her contributions deserve special mention. Special acknowledgements are also due to members of the IITGN community who were involved in conceiving and sustaining the NYASA activity described in this publication. They include Dr Mukta Tripathy, Dr Sriram Kanvah, Ms Monica Yadav, Mr Akash Keshav Singh, Mr Kushal Salecha, Ms Perna Singh and a number of other student volunteers.

The entire project was guided by the Building and Works Committee (B&WC) of IITGN and regularly monitored by the Project Progress Monitoring Committee (PPMC). We acknowledge the constant review, critical advice and guidance of all members of B&WC and PPMC.

This project would also not have been possible without the financial support provided by the Government of India.



Landscape before campus construction begins

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1

Introduction

IIT Gandhinagar, as an institute of higher learning in science, technology, and related fields, aspires to develop top notch scientists, engineers, leaders and entrepreneurs to meet the needs of society, now and in the future. The vision of the Institute includes shaping IIT Gandhinagar into an exciting place for learning, teaching and research; establishing the process of learning that is free, fulfilling and enjoyable; and creating a vibrant atmosphere that breeds innovators, scientists, engineers, entrepreneurs, academicians and the thinkers of tomorrow. The physical design and structure of the campus are meant to encompass this vision and to help bring it to life.

IIT Gandhinagar was created as one of eight new IITs in 2008, with a temporary campus set up that same year by sharing space at the Vishwakarma Government Engineering College in Chandkheda, Ahmedabad. The first batch of 90 undergraduate students joined the Institute in August 2008. In 2012, 399 acres of land for the new campus were handed over by the Government of Gujarat on the western bank of the Sabarmati River. Construction of the new campus began in 2013, and classes began in the new academic buildings in July 2015.

This publication provides an overview of many of the ideas and innovations that were tried in the first phase of construction, along with discussion of those ideas that did not work as well or that presented special challenges. More detail on specific components of campus construction can be found in other publications in this series.

Publications in the series of Campus on the Sabarmati

Planning the Sustainable Campus: Process and Features of Masterplan

Landscape and Open Space Design

Academic Complex: Design Evolution

Design of Housing for Faculty and Staff: An Overview

Student Hostels: Design Evolution

Confined Masonry: For Residential Construction

Water and Wastewater Management

Wayfinding on Campus: the Process of Signage Development

Selection Process for the Architectural Consultant (for Phase II)

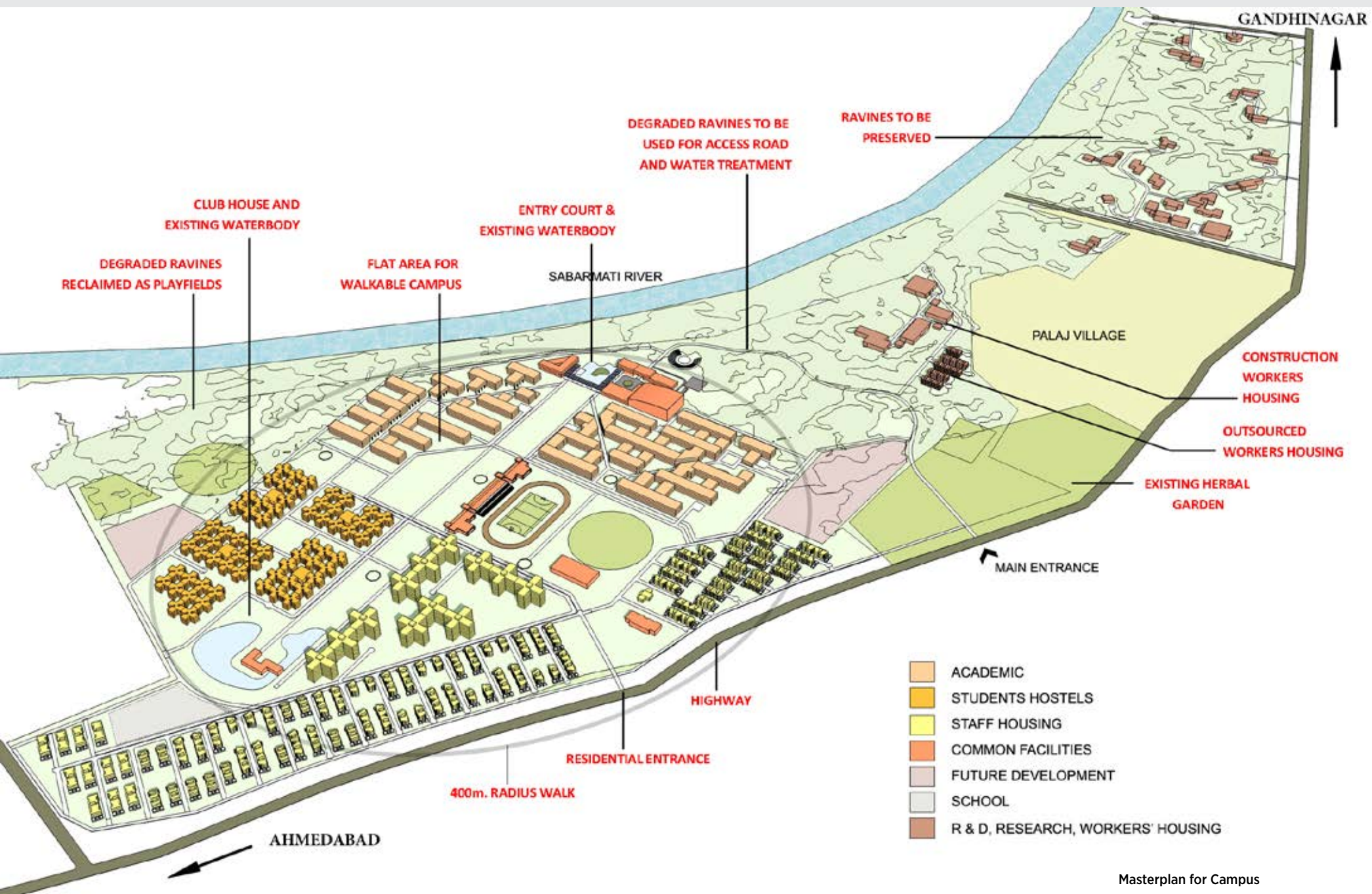
Innovations and Challenges: Construction of a New Campus

IIT Gandhinagar: An Oral History of Campus Development

The 399 acre site has a difficult terrain and only about 55% of the site is available for development in different pockets. The southern parcel has a large contiguous area where the main campus has been sited. The central and northern parcels are smaller and undulating, better suited to small independent uses. The first set of buildings, developed under Phase IA, houses about 1200 students plus associated staff. The first phase of the project has been designed for faculty and 2400 students and the overall plan includes a second phase that would bring the student strength to 4800, with additional growth possibilities to 6000 students. The Masterplan as originally conceived for the campus is shown on the next page.



Director Jain surveys land before any construction starts



Masterplan for Campus

2

Understanding the Physical Planning Fundamentals

Academic Mission informs Campus Development

- The intent of Institute leaders early on was to design a campus where it would be possible to innovate in creating curricula, in organising governance, and in nurturing a unique culture and ethos. The philosophy of education has been to push traditional boundaries with an emphasis on a multi-disciplinary approach with crosscutting thematic areas.
- This out-of-the-box thinking for its academic programmes also translated to campus development. Institute leaders believe that the physical environment makes a huge contribution to shape the processes of learning and knowledge creation.
- Guiding principles of campus development included:
 - » An ambience that attracts visitors and conveys to them that they are on a university campus unlike any they have visited before
 - » Functional convenience for the academic community for mutual interaction, learning and research
 - » Low energy and resource consumption, as well as minimal upkeep and low maintenance costs





View of Lal Minar from Academic Complex

Campus on the Riverfront

- One of the formative defining features of the campus is its location, stretching for about 3 km along the banks of the Sabarmati River.
- The unique terrain of the campus, which includes the wild and eroded ravines along the riverfront, was used in a creative way to draw visitors to the site and to clearly define the spaces and their uses.
- The River Promenade, designed as a broad landscaped walkway, is one of the conceptual anchors of the open space system.



River Promenade

Turning Liability into Asset

- The 399 acre site has a difficult terrain, primarily because of the wild ravines.
- The northern parcel of the campus is to be used only in part, leaving a substantial portion as natural habitat and allowing drainage of rainwater through the ravines from the east into the river.
- The challenges of the physical site have been turned into unique design features of the campus—the ravines are a major anchor of the landscape structure and serve as a contrast to other, necessarily more formal, campus spaces.



Trail along ravine edge

Design Encourages Intermingling

- The academic philosophy central to the establishment of IITGN is anchored by the principle that there are no rigid departments. The physical spaces have thus been designed to encourage cross-disciplinary interaction and fluid movements across buildings and courtyards.
- Common facilities are located centrally, also to encourage ease of access and interaction. These include sport facilities and shops under development. These shops, bank and other facilities that are intended to be used by all staff and residents as well as visitors will line the Central Vista in the centre of the campus, functioning as a meeting point that promotes intermingling.

Central Vista and Spines

- In the shape of a landscape mall, the Central Vista is a major space of the landscape structure and is envisaged as the prime open space of the campus. It is conceived as a broad sweep of open space, 50-60 m wide, to be lined with large shady trees on either side extending from the Arrival Court at the northern end to the staff residences at the extreme southern end.
- Spines or central corridors are used to define spaces in the Academic Complex, Hostels and Housing areas, each in different ways. The Hostels and Housing areas have spines that mimic the winding, narrow streets of old Ahmedabad, while the spine in the Academic Complex provides visual continuity.



Central Vista



Walkway in Housing area

Boundary wall with Palaj

- Early on in campus development it was decided that it would be necessary to build a boundary wall to delineate the neighbouring Palaj village from the campus. Since the villagers were actively accessing the river and using some areas of the IITGN campus land for the grazing needs for their cattle, it was decided to build a low-rise, unobtrusive wall, so that the villagers might be able to cross the wall easily and enter the campus premises as needed. At the same time, the wall served to convey that the villagers were using IITGN's land. The foundations for the boundary wall were designed for a full height wall so that in case a need arises in the future, IITGN could add height to the wall. The current low-rise wall gives the message that both village and campus can co-exist.



Boundary wall with Palaj village

New boundary wall

- A boundary has to fulfil the need for security and privacy as well as present a suitably impressive facade, especially on the highway side. IITGN was particular that it must not appear ostentatious or wasteful nor should it appear uninviting or give a sense of exclusivity. In addition, several panels on the boundary wall were designed for school children to paint social messages. All three security cabins along the boundary wall also have public washrooms that are particularly useful for daily labourers and workers.



Security cabins

Scenic Drive

- The scenic entrance drive passes through the ravines, where the existing natural identity of the landscape is protected.
- The drive emphasises the element of surprise as the buildings of the campus only slowly emerge as one approaches the Arrival Court.



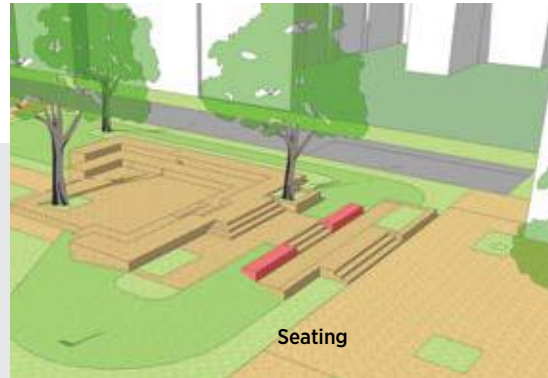
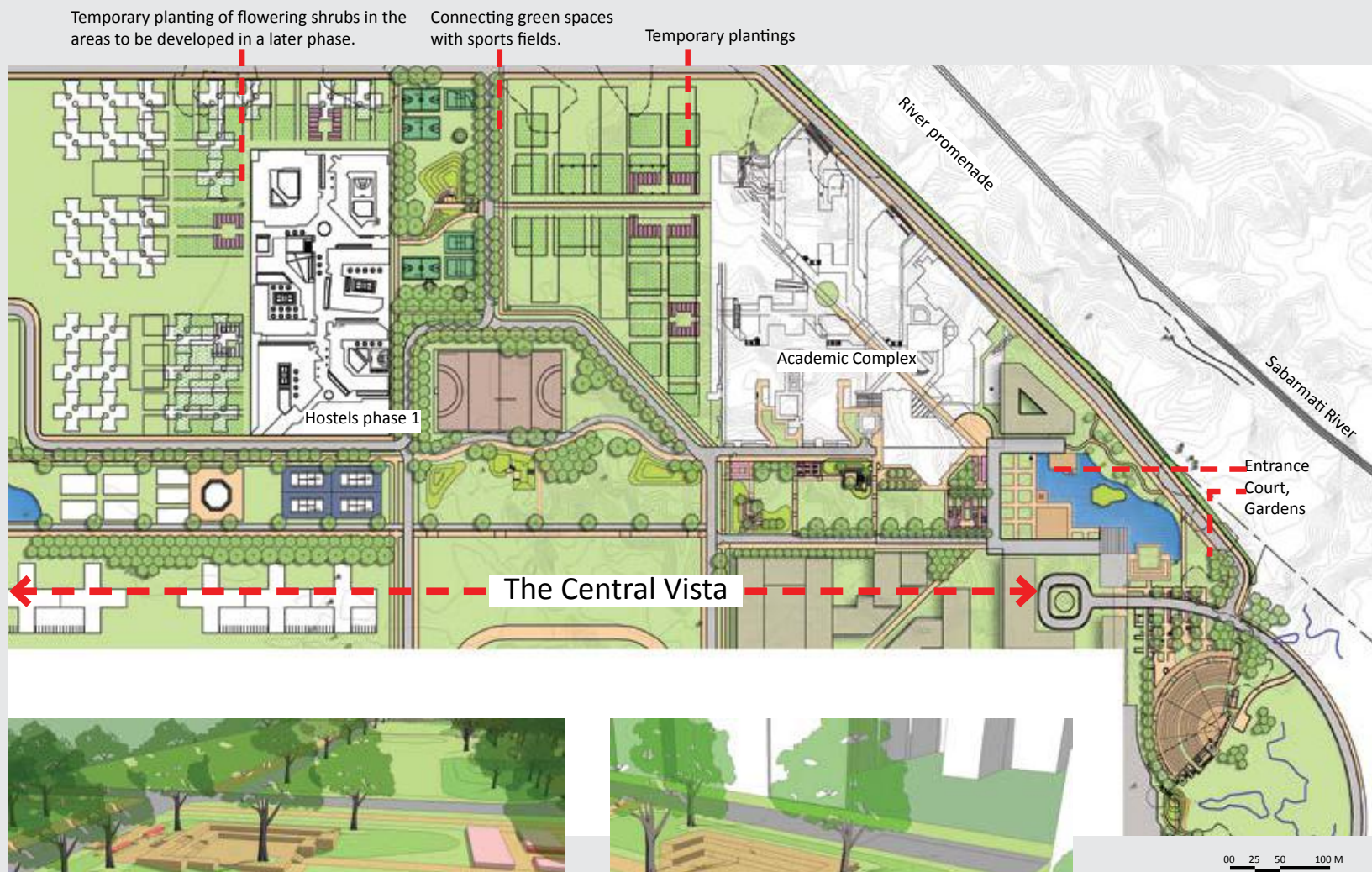
Scenic Drive

Green Campus

- A fundamental planning assumption for the campus is to build a sustainable, eco-friendly campus with minimal impact on the environment.
- IITGN became the first campus in India to achieve the highest, 5-star rating from the Green Rating for Integrated Habitat Assessment for Large Developments (GRIHA LD). GRIHA LD is India's National Rating System, developed jointly by GRIHA Council and The Energy and Resources Institute (TERI), to rate environmental performances of large scale developments such as educational campuses and townships.
- Some of the green features envisioned in the Masterplan and executed in the campus's development (discussed in more detail below) include low-energy sewage treatment, water recycling, rain water harvesting, rooftop solar photovoltaic plants, solar water heaters, passive cooling systems, a pedestrian friendly campus, environmentally-friendly materials used on site, solid waste management, and a biogas plant.

Sustainability is a key focus at IITGN in everything we do and that includes development of our campus. The IITGN Masterplan demonstrates that green initiatives need not come with a hefty price tag.

Sudhir K Jain
Director, IIT Gandhinagar



Central Vista as originally conceived by landscape architect



Meeting with the masterplanners

3

Planning and Managing a Complex Construction Project

Multiple Architectural Firms Shape the Campus

- At the outset the Institute made an important decision to separate master planning and building architecture. The Masterplan development was completed by a consortium of two architectural firms, M/s Green Campus Development consortium, selected through a competitive process. The consortium was created just for the IITGN project so as to pool the expertise and resources of the two firms.
- A separate selection process was conducted for the comprehensive architectural design of the student hostels, the faculty and staff housing, and the academic buildings.
- In this unique arrangement, the master planners/urban designers faced a challenge as to how much to control the character of the buildings (which would be designed by separate firms, over time). Master planners chose minimal control, particularly for building aesthetics, so that building architects would have the maximum freedom of expression to showcase their work. This contributed to a diversity of character in the campus.
- The architectural profession felt that IITGN used a fair method of compensating the architects and designers while meeting the norms for competitive pricing.



Director Jain reviewing the site plans with Chairman, Board of Governors, Dr R. A. Mashelkar before the land is acquired

- IITGN also made a decision to allow relatively smaller firms to take up design work. Typically large campus projects (such as IITGN) are designed by a small number of larger architectural firms, but by allowing smaller firms to compete, and selecting some of these firms, IITGN helped introduce a new generation of architects to campus design work.
- In addition to having the Masterplan and building architecture designed by different firms, IITGN took an even more unusual step to have different components of the campus building architecture designed by different firms to reduce what would otherwise be an overwhelming amount of work for one firm. The three firms were: M/s Mitimitra Consultants Ltd. Pvt, who designed the Academic Complex; M/s Vatsu Shilpa Consultants who designed the Housing area; and M/s HCP Design Planning and Managent Pvt. Ltd who designed the Hostels.
- This decision was considered a bit risky because of the coordination that would be required for the infrastructure such as roads, piping, water and other services that would impact all the components. The resolution was to award a separate contract to one of the three architectural firms designing one of the building components (the hostels). So while there were three firms designing buildings for three campus components, only one firm was responsible for the subconsultants designing various aspects of campus infrastructure. In addition, all three of the architectural firms engaged the same subconsultant firm to design the power systems, the surveillance system, the firefighting and additional general services.



Campus during construction



The compact layout plan developed by Green Campus Development Consortium that was ultimately accepted, allowing for possible growth up to 6000 students

Role of the Owner's Architect

- At the time of preparation of the Request for Proposals (RFP) for the Masterplan, IITGN decided to engage a third party architect to assist in RFP preparation. This exercise highlighted the need for a professional who could act as a bridge between the client and the consultants, and further developed into the important role of Owner's Architect.
- The Owner's Architect advised on the selection process of the various consultants, assisted in programme development and scope, design and drawing review and construction quality monitoring. It would have not been possible to get such a senior talented person on salary (as staff) at IITGN—this was one of the decisions that had a great impact on campus development.
- The Owner's Architect also assisted in the careful documentation of defects in design and construction (which would be expected in a project of this size and built with such speed) and compiled these in a defects manual. This will prove useful to other institutions as well as IITGN in monitoring corrections.

Participatory Process

- A lively participatory process was used to develop the Masterplan, as well as designs for specific elements of the campus, including participation from students, faculty, staff and the Owner's Architect, as well as visitors from other IITs. This process helped impart a sense of ownership in the campus on the part of all these stakeholders. This is tough to achieve, it required a strong will, participation, and vigilance from Institute administration to achieve this.

- A committee, led by the Director, met for all-day meetings, often until late in the evenings, throughout the construction process. It had representation from all the stakeholders, including students, faculty, architects, consultants and CPWD.
- At one of the initial meetings of the Leadership Conclave, a body created to provide strategic guidance to IITGN, a suggestion was made to involve young faculty in designing the campus. This would give them the prospect of ownership in the Institute, and hopefully create a feeling of empowerment. Three different groups of faculty were formed. One group, together with some students, was involved primarily in hostel design. The Dean of Student Affairs, the Wardens and some student leaders would always be sitting with the planning committee whenever hostel designs were discussed. Another group of faculty members were involved in housing design, and the third group of faculty members was responsible for academic building design. All these faculty members and students were welcome to sit in on any other meetings, but they needed to be consulted when their issues were being discussed. There would typically be 20 to 25 people in the room for all-day discussions.

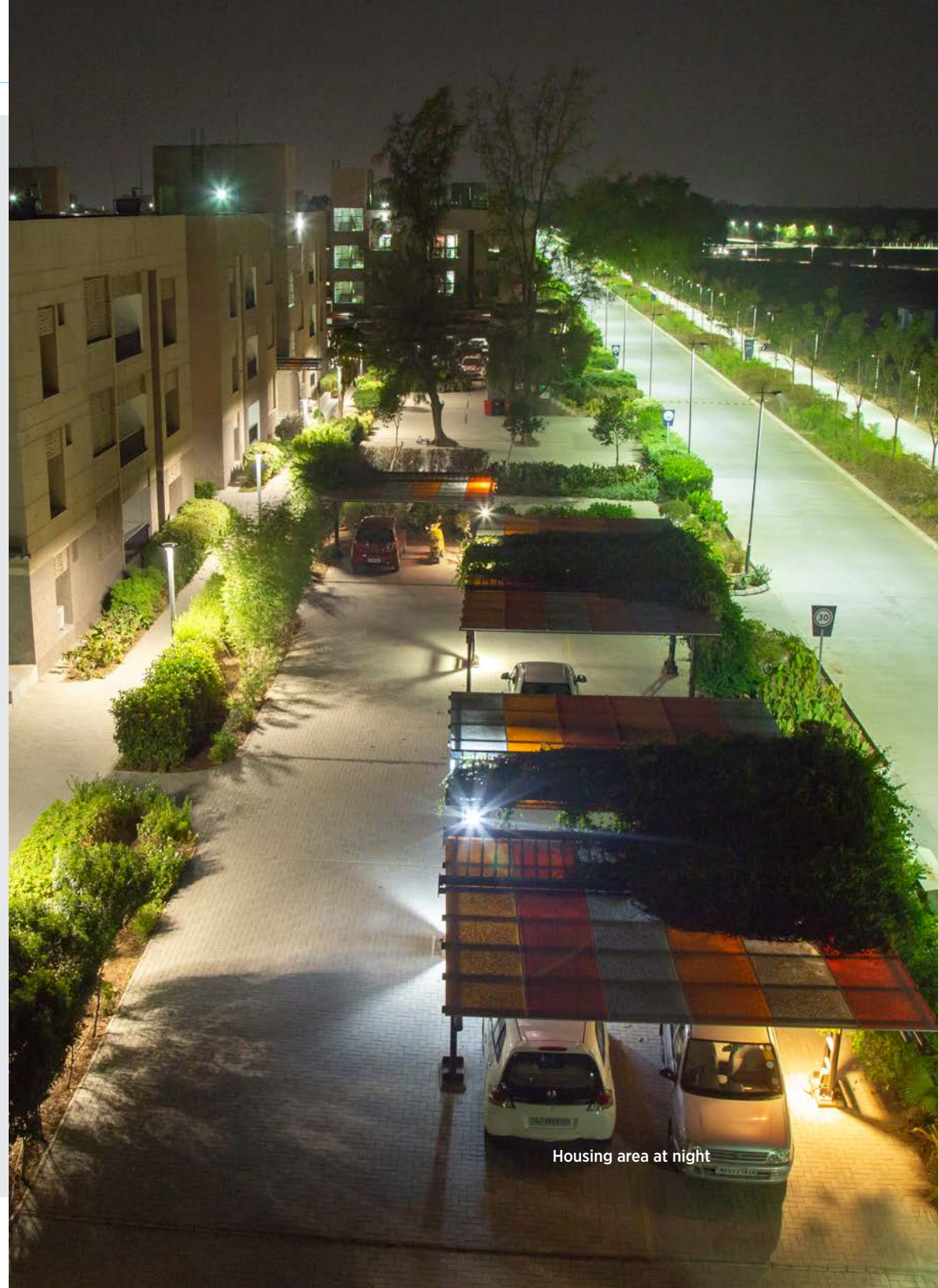


The Owner's Architect, Ar Shobhit Tayai and IITGN Director Sudhir K Jain

- The design approach differed from that of a typical competition where the architect who is awarded the project designs what was proposed. The architects were asked to approach their designs afresh based on inputs from IITGN. For example, it took 15 iterations for the stakeholders (the IITGN community) to be happy enough that the architects could move forward with the Academic Complex design, with further amendments and inputs to be made later.

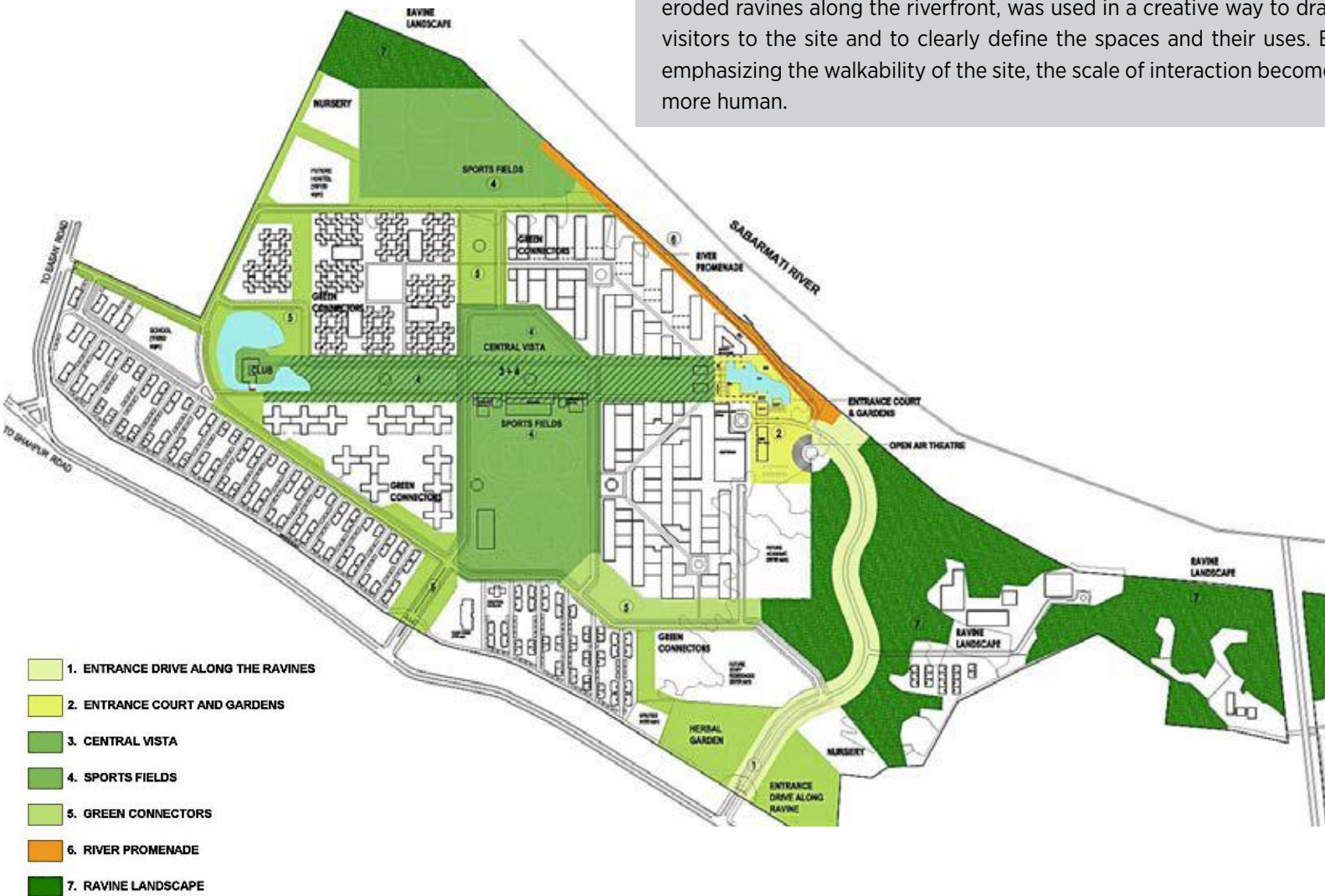
Unique Role of the Landscape Architect

- A senior landscape architect, Mohammad Shaheer, also represented the Masterplan consortium in the competition. His ideas were clearly so creative and thoughtful that the Institute made his continuing participation a condition when awarding the consortium the Masterplan contract.
- The landscape architect and his firm M/s MSYK Design oversaw the landscape design for the overall elements and spaces of the new campus. He also peer-reviewed the landscaping developed as part of the hostels, faculty and staff housing, and academic buildings. There is thus continuity in the plantings across the different elements of the campus.



Housing area at night

The very unique terrain of the campus, which includes the wild and eroded ravines along the riverfront, was used in a creative way to draw visitors to the site and to clearly define the spaces and their uses. By emphasizing the walkability of the site, the scale of interaction becomes more human.



Organisation of green spaces

Project Execution

- The construction was managed by the Central Public Works Department (CPWD) of the Government of India and they are fully responsible and accountable with regard to project management and execution. However the IITGN team and CPWD engineers developed a close working relationship that allowed them to share ideas, debate problem-solving approaches and collaboratively find solutions and streamline the construction process.
- The Institute recognized early in the process how critical to success it was to build mutual trust with CPWD. The CPWD project manager was made a permanent invitee of the Institute Building and Works Committee and invited to every meeting. He became part of IITGN's decision making and took ownership in IITGN's mission to build an outstanding campus. The CPWD team was seen anything within its means, including as part of the Institute and IITGN assisted them with offices, computers, printers and furniture. A connection between the two organisations was forged at a personal level. IITGN was a very active partner in the construction process.
- Similar to the strong role described above for the Owner's Architect, the Institute also brought in a strong engineering team consisting of Advisor (Works), a Superintending Engineer (from another government department on deputation) and other engineering staff. This helped the Institute be sensitive to CPWD constraints. The engineering team represented IITGN's interests in decisions related to the construction process. IITGN was lucky to find senior people for these positions, several of whom came from very senior posts within CPWD and so were familiar with CPWD processes and procedures, and were able to act as strong advocates for IITGN.



Construction workers on site



Reviewing construction progress with the Director Jain

- At the peak of construction for Phase I there were 15 CPWD engineers working on the project, coordinating ultimately 27 different construction contracts.
- Also at the peak of construction there were approximately 2700 workers on-site coming from 9 states across India. It is estimated that more than 10.5 million man hours went into the project.
- One early challenge facing campus designers was the fact that the site survey that was conducted as part of the initial background provided to firms bidding on the work was incorrect (the terrain was so difficult the surveyor did not actually walk through the site). And in fact when the master planners had the site re-surveyed their surveyor used the same incorrect data. It took several iterations to truly understand the site's topography.
- A number of expert committees were established to give advice on various design and construction issues. These committees were mostly formed with experts from other IITs, other institutes and industry, and IITGN faculty.
- IITGN and CPWD undertook several project management initiatives that facilitated the completion of construction of Phase I in a short span of time. They conducted a comprehensive assessment of the requirements in particular related to bulk services and infrastructure and worked out a methodology to put all services in position along with the buildings. Some of the tasks involving state government and local authorities, such as main electrical connections, PNG connections and the water pipeline, were taken in hand by IITGN directly, rather than through CPWD.



Phase 1 construction in progress

- For some of the work where CPWD felt that the job could be handled more expeditiously and properly by IITGN, such as the selection and installation of furnishings and plantations, IITGN managed the work directly.
- A Project Progress Monitoring Committee (PPMC) was constituted by the IITGN Building and Works Committee to provide oversight as the work progressed. This committee would meet regularly with CPWD and the contractors and facilitated the resolution of site-related issues. This committee set careful boundaries for its role and never intervened in contract management, which is the sole domain of CPWD.
- IITGN insisted with CPWD that the defects liability period be three years with each of the contractors. Normally such a period is only one year, but IITGN understood that the campus would not be fully occupied from the first day and it might take some time and use before certain defects, especially functional, would show up.
- IITGN decided on a five-year operation and maintenance clause for all electrical and mechanical installations (ELV system, HVAC, video, e-learning, lifts). IITGN paid for the first year of comprehensive maintenance and defect liability. Contractors were required to include in their original tender documents their rates for the next four years of comprehensive maintenance and operation, making them responsible for the quality of their work through this period.
- As with any large-scale construction project, there are mistakes that have been made, either in design or construction. IITGN has attempted to document as many of these as possible, with the intent of avoiding the same mistakes in subsequent phases of construction.



Confined Masonry housing under construction

Confined Masonry and FALG brick plant

- The housing and hostel areas are the first large-scale application of engineered confined masonry in India. It was chosen because of its superior performance in earthquakes and is appropriate for low-rise construction such as housing blocks.
- The fact that it was a new technology meant that engineers and contractors were not familiar with the typology. CPWD had to innovate on contract management (e.g. measurement of building materials) and train the contractors on the special nature of confined masonry.
- A large number of fly ash (FALG) bricks of high strength were needed and CPWD could not find a source that could provide the quantity and quality needed. It was thus decided that a brick plant be built on-site to produce bricks of the required strength. During the height of construction 65,000 bricks were made on-site each day.
- In addition to the use of FALG bricks, lime cement mortar was used for the confined masonry work. The practice of using such mortar in India is no longer prevalent; thus CPWD had to do a certain amount of reeducation with the contractors.



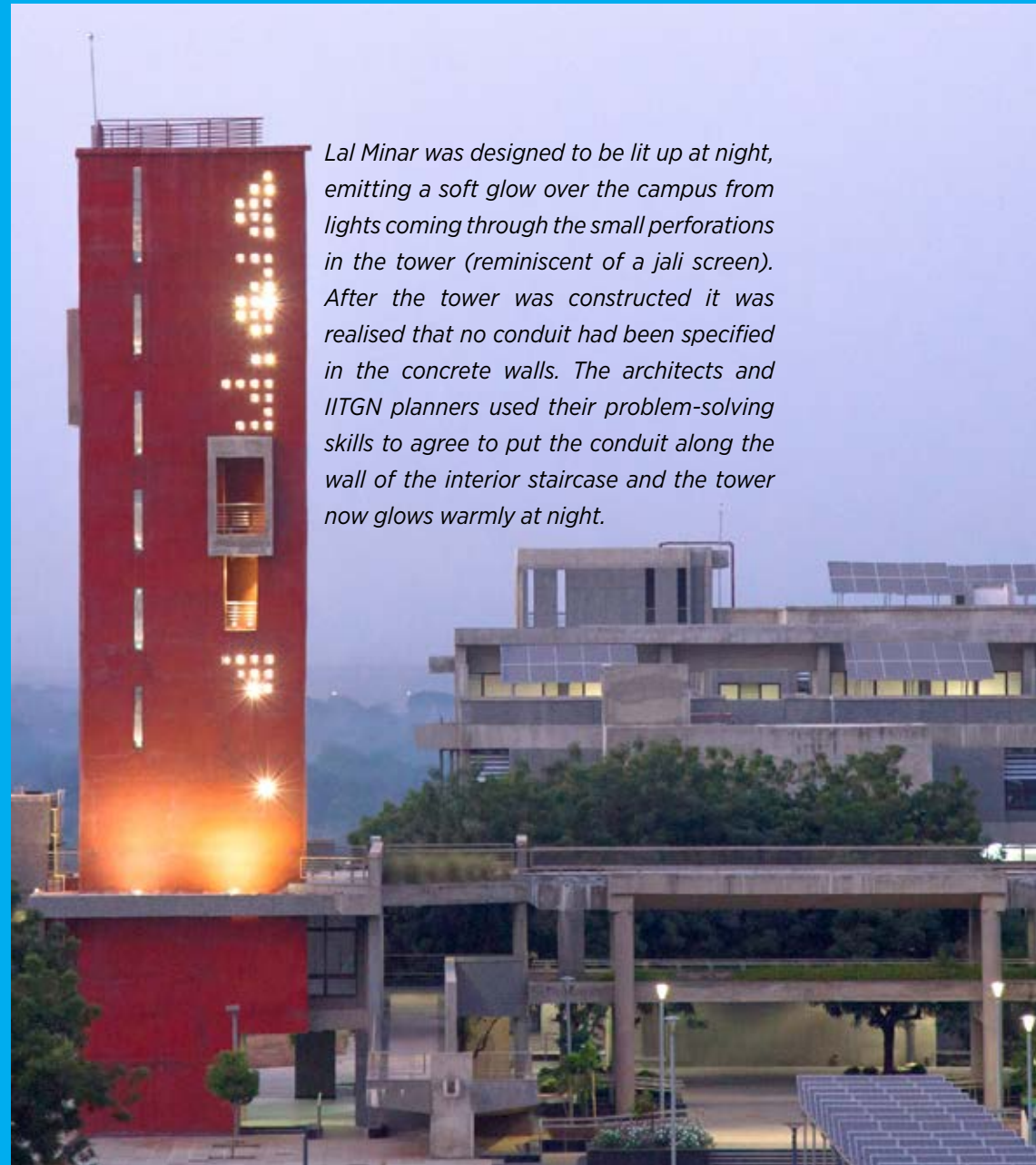
Locally sourced fly ash was used to manufacture the FALG (fly ash) bricks on site



Locally sourced fly ash was used to manufacture the FALG (fly ash) bricks on site

Challenges: Space Frame, Tower, Ravines

- The space frame presented engineering challenges to construct. It is 1200 sq m, 12 m high and 20% of it is cantilevered. It was erected after all nearby buildings were constructed, creating safety and structural stability concerns. The frame has 916 nodes, most of which have 8 to 9 members coming out of each. It was hoisted by crane in three parts—each part was hoisted and kept there with the crane for three days for careful testing of all the connections. After three days the crane was removed.
- The face of Lal Minar (the tower) has an abstract design loosely inspired from an ancient sundial. It is perhaps the largest such concrete embossing in India. The time wheel is 4.2 m in diameter and is 75 mm thick. A 5 m x 5 m formwork was created at ground level for the symbol and then carefully hoisted in place with a crane.
- The location of campus features close to or through the ravines presented additional engineering challenges. Academic Buildings 4 and 9 required foundation modifications because of their close proximity to the ravines and the unstable soil. The C-2 road behind the hostel block as well as the Scenic Drive pass through ravines that are 5 to 10 m deep and required additional engineering considerations. Service corridors for the needed pipelines were also limited because of limitations of the campus area. It was necessary to lay multiple pipelines in layers in the same trenches.



Lal Minar was designed to be lit up at night, emitting a soft glow over the campus from lights coming through the small perforations in the tower (reminiscent of a jali screen). After the tower was constructed it was realised that no conduit had been specified in the concrete walls. The architects and IITGN planners used their problem-solving skills to agree to put the conduit along the wall of the interior staircase and the tower now glows warmly at night.

Transition of Responsibility for Maintenance

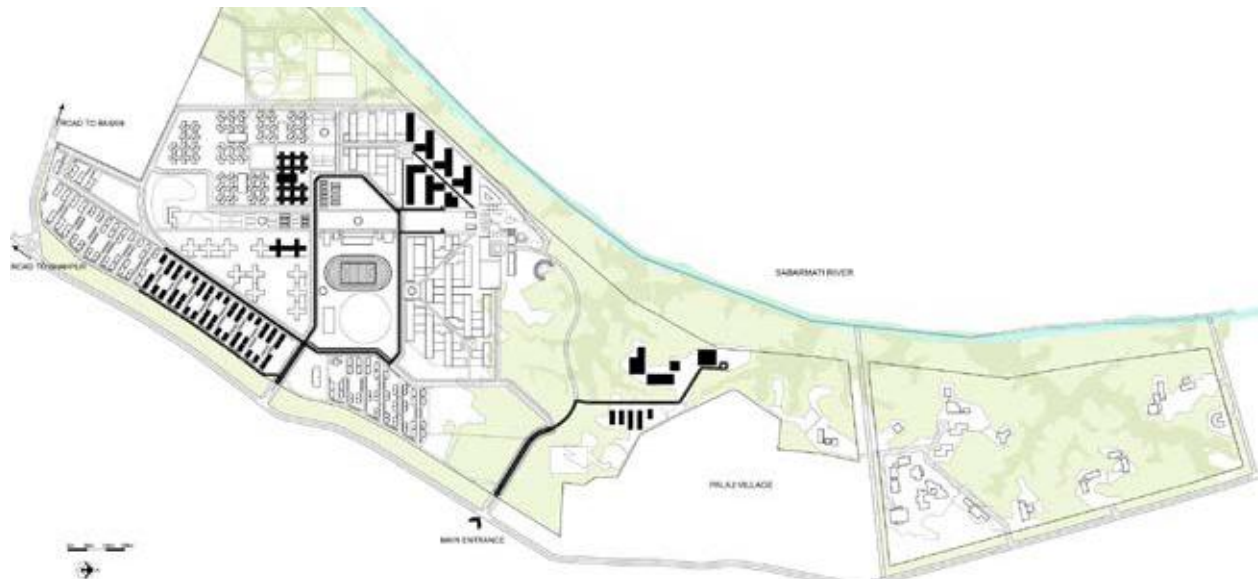
- Starting in April 2018, IITGN engineering staff took over maintenance and management of the entire Phase 1 campus from the Government of India's Central Public Works Department (CPWD).
- CPWD has now undertaken Phase II construction, including the Director's House, the guest house, additional hostels, additional apartments, a sports complex and shops, and new academic buildings.
- The impact of all this new construction in the middle of a functioning, residential campus presents many new challenges. This includes the impact of construction vehicles on traffic on campus and the impact of construction noise and equipment on academic life. Careful planning was carried out to guide the management of the new construction, including the routes for movement of construction vehicles for each project, the site for the concrete plant, etc.
- During the master planning phase the architects were asked to develop a sequence of construction for the various phases, so as to minimise disruption to the existing campus. They thought through the order of the phases and provided guidance in the Masterplan so that the entire campus would not be a construction site as new phases were undertaken. The figures on the next page illustrate the phasing as envisioned by the master planners.



Phase II construction underway for Hostels



Phase II construction underway for Guest House



C3-4 FIGURE/GROUND MAP : PHASE I a



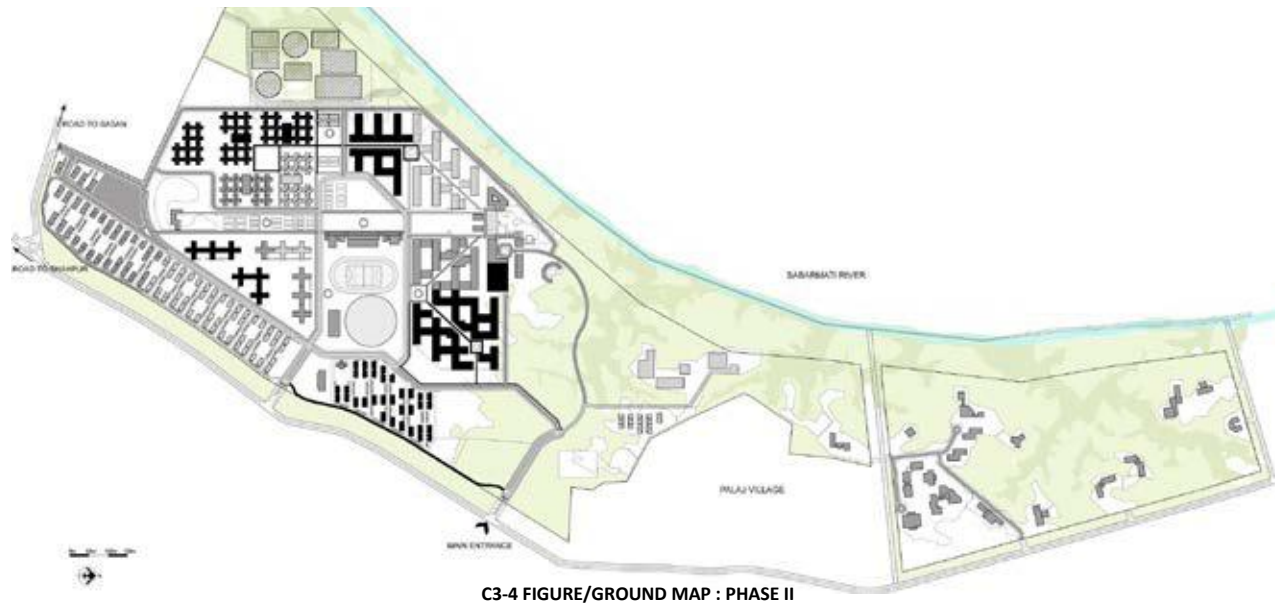
- TO BE BUILT
- CURRENT PHASE
- PREVIOUSLY BUILT

GREEN CAMPUS DEVELOPMENT CONSORTIUM

C3-4 FIGURE/GROUND MAP : PHASE I

MASTER PLAN : IIT GANDHINAGAR

(a)



C3-4 FIGURE/GROUND MAP : PHASE II



C3-4 FIGURE/GROUND MAP : PHASE III

GREEN CAMPUS DEVELOPMENT CONSORTIUM

MASTER PLAN : IIT GANDHINAGAR

(b)

Figures a and b illustrate the approximate sequence of construction - which sections of the campus are to be built first, then next, so as to minimise disruption as envisioned by the master planners

4

Living in a Harsh Climate

Architectural Design to Minimise Heat Gain

- The architects for each component of the campus all used various design features and architectural elements to minimise heat gain.
- For the academic buildings, solar shading analyses indicated that it would be most effective to orient the buildings with the longer sides of the buildings facing towards the north and south. It was also decided that the intermediate open spaces and courts used during the day be augmented with landscape design elements such as canopy trees, vine trellises and pergolas. Window louvers were installed to reduce heat gain, with studies indicating they provide more than 85% shading all year round. Cavity walls were also used to increase cooling in the academic area.
- In the Hostel Complex where the buildings are closer together, the shadow pattern analysis conducted at different times of the day over a one-year period was used to determine the best orientation of the buildings. The architects also judiciously designed the placement of the windows to take advantage of the shadows cast by neighbouring buildings. On the ground and first floors of the west facing walls of the buildings, the windows were oriented straight out, because they will always be in the afternoon shadow of the neighbouring building. The second and third floors of the same buildings, however, have windows that are recessed at an angle so the sun will not shine directly in. These floors do not benefit from the shadow of the neighbouring building.



Shade provided by deep verandah

Role of Daylight in Climate Modification

- One goal in the Academic Complex was to have openings on the north side of buildings, resulting in more reflected light and less heat.
- Since the south light produces the strongest light, but with associated glare, the architects chose to thus emphasise this light in the public areas of the Academic Complex, such as passageways. To control the glare the architects recessed windows in by 1.5 m and used louvers. Also in general the passageways are connected to the outside, diffusing the glare.

Preservation of Existing Trees

- An important element in creating a cooler environment is the use of trees. There were nearly 2500 trees at the site when construction started. Out of these, fewer than 150 were cut down. 75 neem trees were transplanted along the boundary (56 of which survived and are in full bloom). Ninety percent of the trees have been kept intact through careful siting of the buildings.



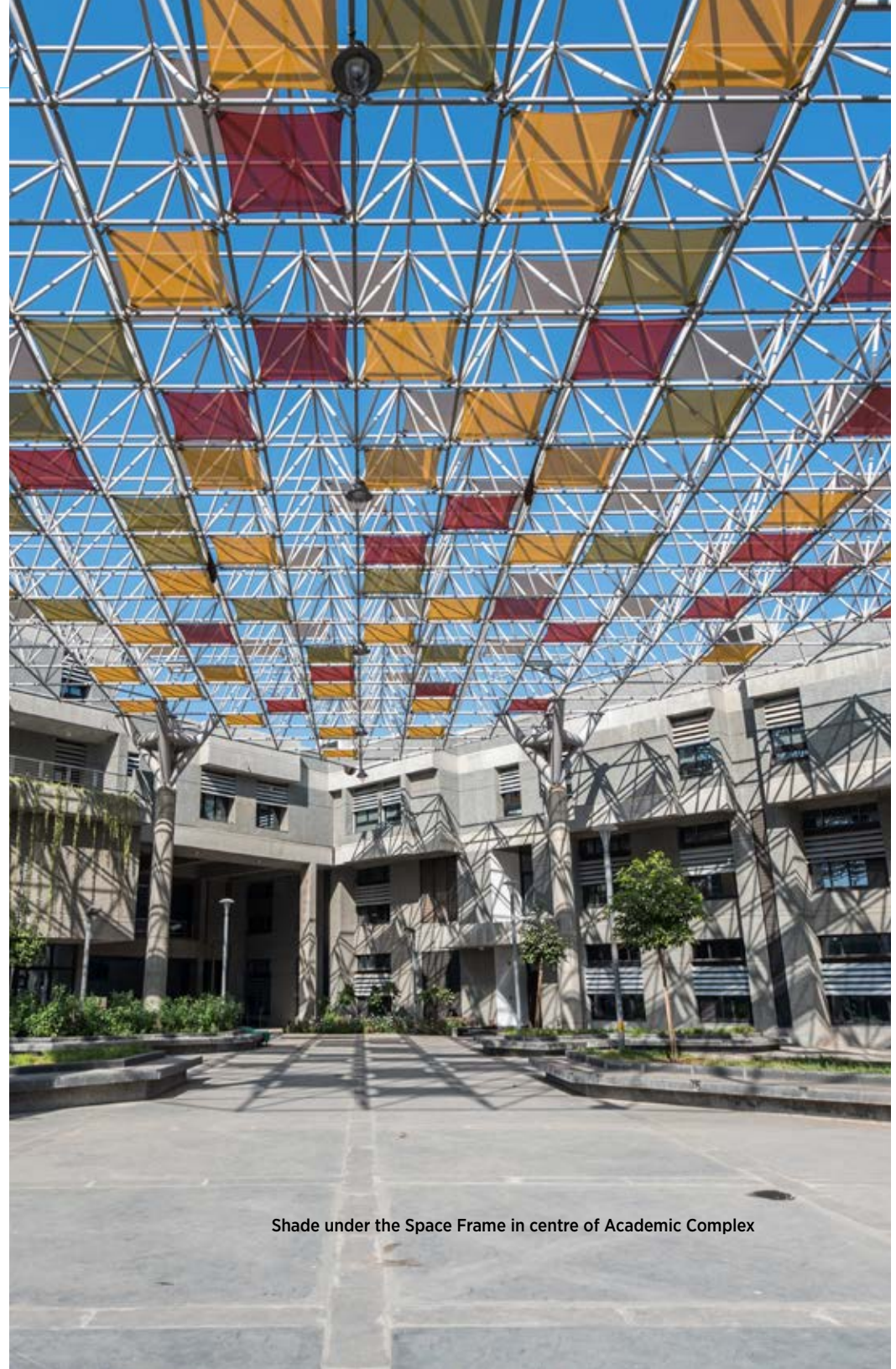
A hostel building with windows on the first two floors facing straight out (in afternoon shadow), while second and third floors have windows recessed at an angle



Tree transplantation

Strategies to Reduce Heat Gain/Increase Cooling

- An analysis of possible building materials indicated that fly ash bricks and concrete blocks would generate the lowest heat gain. Ultimately the architects for the Academic Complex opted for fly ash bricks alone as the difference in heat gain was too little to justify the added complexity of procuring concrete blocks. Fly ash bricks were used in the cavity walls and outside walls of academic buildings, and in the housing and hostel buildings.
- Techniques were used to shade buildings during the day as much as possible, through the orientation of buildings to each other and the use of the terrace on Building 7 in the Academic Complex.
- Wall-mounted furniture was avoided and thermal mass was moved closer to occupants. During the day heat is gained from the sun, the occupants and the equipment, but is absorbed by the concrete floor slabs. By the end of the day the slab has warmed up but as air temperatures cool, this heat can be released, carried away by the ventilation system.
- A cavity wall system, primarily in the walls facing west and south, was used in buildings 3, 4, 5, 6 and 7 in the Academic Complex. In this system, air cavities of 300--450 mm wide are built between two skin walls, reducing heat gain in the buildings.



Shade under the Space Frame in centre of Academic Complex

Variety of Passive Cooling Techniques

- As part of the design process, a workshop was convened with experts from the green building industry and academics from IITGN to discuss the most appropriate cooling techniques and associated costs for the campus. Different techniques were implemented throughout the campus.
 - » Design of the housing buildings was meant to increase cooling. Cross ventilation has been provided in all the apartments, with two balconies, and two windows in each bedroom, Jali screens have been provided to reduce glare.
 - » In the Hostel Complex the Dining Building has a Passive Downdraft Evaporative Cooling (PDEC) technique installed, using a mist pump. The dining building occupies a pivotal position in the Hostel Complex. During meal times this area is a hub of activity. An open platform functions as a spill-over space that has been developed as a shaded outdoor dining area. A central facility for all students with two independent mess facilities, the building is equipped with modern kitchens. This two-storey building caters to 1200 students. It has been designed specifically to cater to the harsh climate of the region. A Passive Downdraft Evaporative Cooling technique using a mist pump has been adopted very effectively. It helps reduce the indoor temperature with hardly any energy consumption.
 - » In the Academic Complex Building 7 used a combination of a PDEC mist pump, a night purge system and a cavity wall system. Building 6 also used the night purge system for 50% of its building



A jali screen in a Housing Block



Passive cooling at dining building

area. In the lab buildings in the Academic Complex--Buildings 3, 4 and 5-- air conditioning was installed from the beginning to keep the spaces, equipment and contents at a comfortable temperature. Building 7 is discussed in more detail below.

Building 7 in the Academic Complex— Designing, Monitoring, Adapting

- The intent of campus planners was to use Building 7 as a living laboratory, implementing several techniques and developing a building monitoring system to aid in systematic data collection for the building.
- Based on analysis of possible designs, the architects proposed an integration of a cavity wall system, night purge cooling and evaporative cooling.
- Eight rooms were designed with a cavity wall system, with air cavities of 450 mm wide between two skin walls. The upper levels of the outside wall windows have aluminum fish-shaped louvers to cut down on the incoming radiation and glare. The inner walls have verandahs and a corridor that acts as a buffer space opening into an internal courtyard. Each classroom has windows that open to the outside as well as vents that open to the hallways so that there is continuous cross-ventilation.
- The second group of classrooms used the night purge ventilation system, where the top extractors run through the night to flush hot air from the classrooms. The outside wall windows were provided with night louvers that opened and facilitated the fresh air inflow inside the classrooms. During the day the windows were to be



Entrance to Building 7



Interior courtyard of Building 7

closed and heat gained is largely retained in the thermal mass.

- The third set of classrooms was designed originally to be cooled by the Passive Downdraft Evaporative Cooling (PDEC) technique. In this system water enters a shaft from several nozzles and sprays a light mist in the shafts. Air enters at the top of the shaft, and cools down as it moves through the mist and down the shaft, where it then enters the classrooms through specific louvers.

Building Monitoring System to Manage these Cooling Strategies

- To keep track of the effectiveness of each of these cooling systems a Building Monitoring System (BMS) was put in place.
- In particular the BMS was set up to monitor data connected to the PDEC shaft. The humidity in the shaft was controlled by a solenoid control valve that is activated according to BMS-specific programming.
- Data were monitored on an hourly basis, 24 hours a day. The intent was that whenever there was a temperature difference of more than 6 to 8 degrees between the inside and outside, exhaust fans would start until the inside and outside temperature difference was less than a degree.




Trees growing along the walking paths will provide more and more shade

Challenges with the Passive Cooling Systems in Building 7

- The recorded data indicates that on a good day the passive cooling helped achieve a few-degree temperature drop in some of the classrooms in Building

7. However the performance varied, and the cooling was not as effective on the first floor, and operational issues presented challenges.

- The blower/fan installed for night purge and also used to supplement the PDEC system generated a noise of 83 dB at the source and 79-81 dB in the classrooms. This was a nuisance for the students and faculty. A Variable Frequency Drive (VFD) was installed to reduce the fan speed in an attempt to reduce the noise level. The noise level then dropped to 65-67 dB in the classrooms.
- The sensor locations in many instances were too close to the shaft or are in inappropriate locations, requiring the use of portable sensors for monitoring performance.
- Initially the vents in the classrooms were installed with the incorrect orientation. In addition, the shaft had openings from the outside, causing mist in the shaft to escape through these openings instead of entering the classrooms. The openings were subsequently plugged.
- A moderate to high amount of misting caused the relative humidity to rise beyond 80 to 85% in the ground floor classrooms, leading to standing water on the floors and incompatible environment for the electronics, projector and computers installed in classrooms. The high humidity and condensations remained a major inconvenience for the students.
- The entire night purge system is designed to flush heat in the nighttime, but this works best if the building can be closed up during day time and opened again in the evening. Continuous use means the system is less effective.
- After monitoring the alternative cooling systems in Building 7 for two seasons, IITGN decided to install air conditioning in the classrooms of this building. The extreme spring/summer heat and the noise associated with the PDEC system made these spaces uncomfortable. Because the building has these passive cooling systems as well as architectural features that reduce heat gain, the amount of energy needed to run the air conditioning system in this building will be less than for a standard building.



The extreme summer heat has proven to be a challenge in terms of using passive cooling techniques for so many different spaces, uses and populations. As the campus has developed during Phase I, air conditioning has been introduced into various buildings, including guest quarters in the staff and faculty housing, the classrooms and laboratories in the various buildings in the Academic Complex, including Building 7, and the student hostels. Passageways are not air conditioned, reducing the demand on the system. The AC in the student hostels has been installed to only run at night, saving electricity during the day when most students are in the Academic Complex. AC runs in the Academic Complex during the day.

Trees providing shade in Academic Complex



Seasonal pond by Arrival Court

5

Using Water as a Core Element

Water Features

- Water features are extensively used throughout the campus landscape. One of the guiding principles for campus development was to preserve the natural water bodies and landscape, as well as drainage channels.
- Not just a visual element, water is also used as a cooling agent. All the water bodies are part of the water management system.
- Strategies for water harvesting and conservation are also integral to campus development.

Riverfront Access

- One of the particularly unique features of the campus is its proximity to the Sabarmati River. A river promenade has been designed to connect the Academic Complex with the river. There is a raised path along the buildings and a pedestrian path along the site edge.



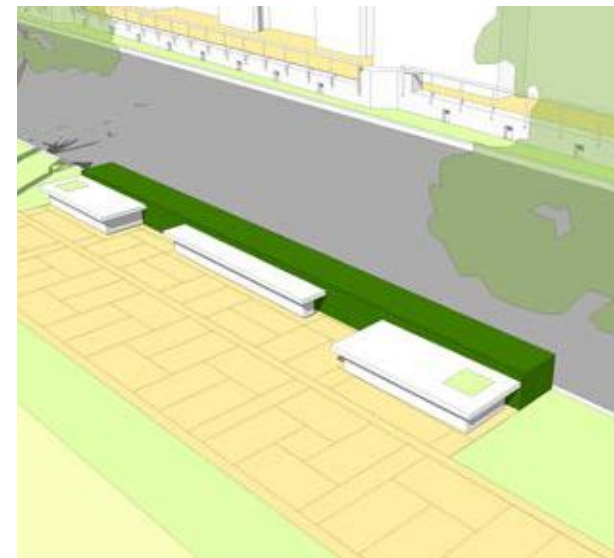
Darpan in Academic Complex



River Promenade Plan



Detail



Protecting the Ravines

- As mentioned earlier, the 180 acres of deep gullies and ravines presented particular challenges in the construction, both in terms of the location of the academic buildings and the scenic drive and infrastructure through these ravines.
- The ravines range in depth from 6 to 10 m or more. Portions are below the highest flood level and are thus susceptible to flooding and backflow from the river extending into the site in the rainy season.
- To protect further damage to the ravines through erosion, care was taken to minimise discharge of runoff. One measure that was used to arrest erosion was to build a few check dams at key locations. These small dams consist of a minimal stone wall at the lowest and narrowest point in a ravine to hold back soil and moisture that is washed through the ravine during the monsoons.
- Originally the landscaping work in the ravines called for stone pitching to hold the hillsides. However when campus planners were introduced to geosynthetics they realised that this might be a better option for hillside stabilisation while keeping the slopes green. They began using geosynthetic fabrics with a toe wall of gabion on the ravine slopes. These fabrics are made from polymers and have the advantage of being both permeable and flexible by growing grass on top with their roots gripping the soil below.
- Protection of the site from erosion requires embankments to be built in areas that lie outside the site of IITGN and fall within the purview of the state's flood control department.



Deep Ravines



Scenic Drive through the Ravines

Use of Seasonal Landscape Ponds

- The Central Vista is anchored at both ends by landscape ponds. These ponds are natural depressions on the site that fill with water seasonally, during the monsoons.
- Originally the surface rainwater runoff network was designed so that the collection pipes would feed water into these two ponds. However due to various site conditions, these pipes had to be installed at a depth below the ponds. There are now open intake wells at both ponds and water is pumped from these wells to the ponds.



Seasonal pond by Housing and Hostels

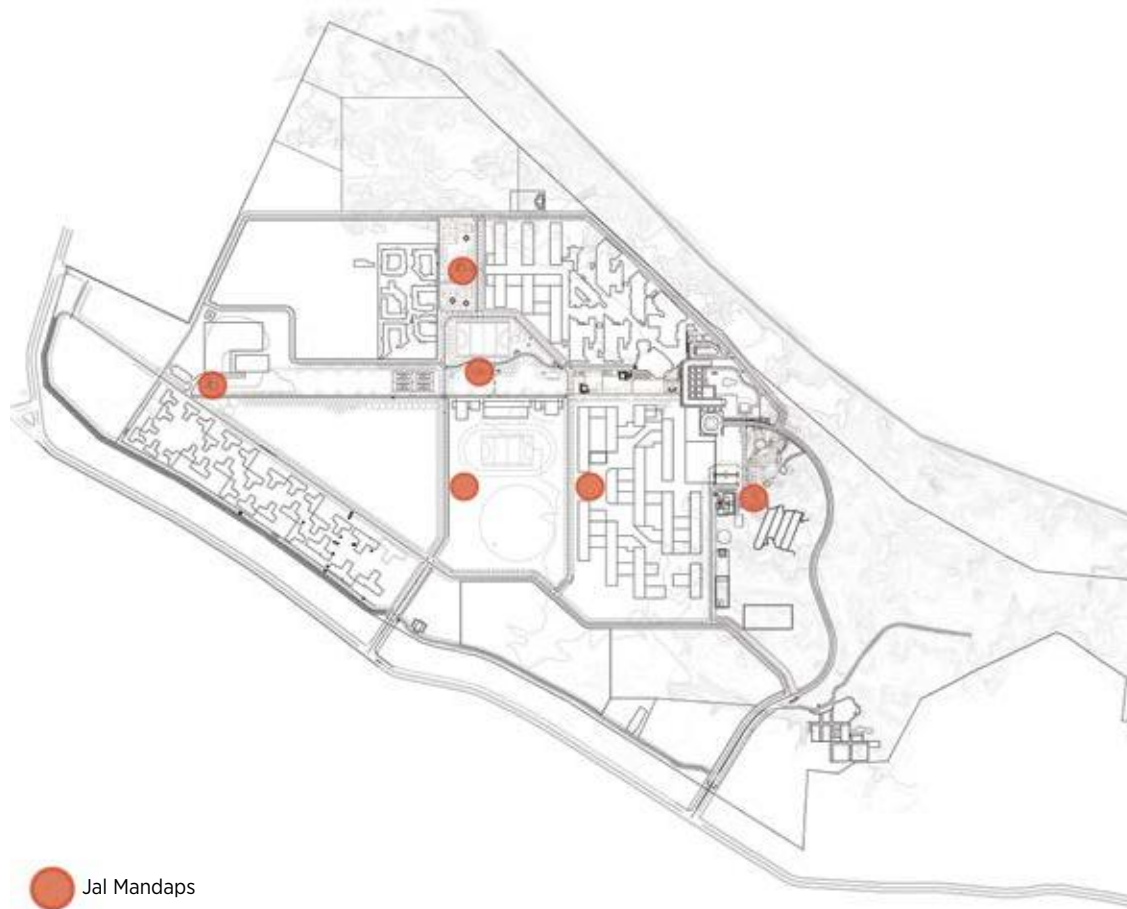
Rainwater Harvesting and Storage: Jal Mandaps

- A unique system of rainwater harvesting has been developed on campus. All the rooftops of the campus buildings are connected to a stormwater collection pipe network. These pipes are then connected with a gravity feed system to four (ultimately six) rainwater storage structures located throughout the campus.
- These rainwater storage structures each have pavilions associated with them. They are inspired by the concept of associating architectural features with water conservation structures, e.g. stepwells or *vavs* in Gujarat. The landscape architect called these pavilions *Jal Mandaps* and designed them as an integral part of each water tank to mark its presence and to serve as a means of access.
- The rainwater collected in each of these Jal Mandaps is pumped to the Water Treatment Plant where it is mixed with Narmada Canal water, treated, and piped back to the rooftop tanks to be used eventually for kitchen and bathing purposes.



Jal Mandap

- Each Jal Mandap stores between 620 and 1415 cubic metres of water. There are 42000 sq m of rooftop area that drain into the Jal Mandaps, and assuming average rainfall, these tanks can collect 26075 cubic metres of water in the rainy season. This is enough water to sustain the campus for approximately 40 days.



Key plan showing locations of all 6 Jal Mandaps



Shredding green waste on campus

6

Designing a Green Campus

The Green Office Team

- A Green Office team, composed of volunteer participants from faculty, students and staff, has been established at IITGN to make the Institute a green institute by:
 - » Participating in institutional management practices, such as energy, water, waste, construction project, natural resource (forest, water etc.) and biodiversity conservation.
 - » Encouraging people to “Reduce, Reuse and Recycle”
 - » Implementing various activities that will contribute towards eco-friendly and sustainable practices on the campus and neighborhood villages.

Recycling and Organic Waste

- In what is still uncommon in India, the Institute has taken the progressive step to segregate and manage all solid waste, with an ultimate goal of generating zero waste for landfill. This requires the reduction and segregation of waste at the source, as well as appropriate collection, storage, treatment and disposal on campus.
- Green, blue and red bins have been placed throughout campus, including the hostel and housing areas. Green bins collect organic wet waste, such as vegetable peels and food scraps. Blue bins collect recycling material and red bins collect remaining materials that need to go to the landfill. Black bins collect sanitary and bio/medical



Collecting recycling and waste in the Housing area

waste that is collected by an authorized agency for incineration at their facility.

- Material from the green bins is put either in the biogas plant or in one of several compost pits, where it is combined with shredded vegetation and leaves coming from the landscaping. Once it is composted (after about a month) the material is spread as a compost layer in the landscaping.
- Food waste from plates, primarily from the hostel mess, is segregated at the source and is fed to the biogas plant. The compost pits take all other organic kitchen waste—vegetable peelings, etc.
- Material from the recycling blue bins is sorted and segregated on campus and sold every ten days or so to aggregators off campus. In a typical year the campus has been generating revenue of about Rs 1 lakh through these sales.
- Material from red bins is taken directly to the Gandhinagar Municipal Corporation landfill for the moment. This is primarily low category waste that cannot be recycled. IITGN is looking at options for the safe disposal of this category of waste as well.

Initiatives to Encourage Waste Reduction

- Diverting waste from the landfill requires a significant educational shift on the part of the entire campus community. More than just using trash bins, the goal of zero waste to the landfill requires the reduction of total waste as well as the segregation of recyclable and organic waste.



Explaining the segregation of waste



Compost pit

- Initiatives to encourage waste reduction have been developed, such as using reusable glasses in the tea stalls and at conferences, etc., instead of paper or plastic.
- A green bottle initiative has been in place for several years throughout campus, where campus staff, students, faculty and visitors are all encouraged to use reusable green plastic water bottles rather than single use plastic water bottles. In meetings green water bottles are provided rather than plastic, and most guest apartments are provided with such bottles.

Need for Training and Capacity Building

- Staff who provide services such as cleaning, food preparation, and gardening are all trained in handling all categories of waste. Their role is critical in managing the solid waste in the campus. However, it is the responsibility of every member of the IITGN community to try and reduce waste and to appropriately segregate waste at the source.
- The Institute's Green Office is actively involved in waste reduction initiatives, along with other green campus efforts. M/s Pro Waste Concepts Pvt. Ltd assists the campus to manage the entire solid waste management programme, through the regular training of staff, monitoring the implementation of the various initiatives and providing general education to the campus community on the need for and benefits of waste reduction.



Students observing green waste shredder

Biogas Plant

- As part of IITGN's waste management initiatives and to minimise waste going to the landfill, the campus built a biogas plant to process the wet food waste (coming primarily from the hostel mess). This biogas plant, based on technology developed by the Mumbai-based Bhabha Atomic Research Centre (BARC), generates compost and electricity from organic waste, with no other by-products. However, as the biogas plant has not been running as reliably as hoped, campus planners are now more reliant on the compost pits where food waste and vegetation is being turned into compost to be used in the landscaping.



Learning about solid waste management



Explaining the Biogas plant



Students visiting the biogas plant

Zero Sewage Discharge

- There are no outgoing sewage lines from the campus to the municipality, making the campus a zero-discharge campus. All wastewater and sewage generated on campus is treated through anaerobic reactors and a root zone treatment system. This recycled water is then piped separately throughout campus and is currently used for irrigation.

Mobility without Cars on Campus

- One of the goals of the new campus is to be car-free. The Masterplan specified that the actively used areas of the campus be kept small enough for walking and that the use of automobiles be limited to connections with the surrounding areas. Using appropriate planning measures, such as shaded and rain-protected walkways, walking can be encouraged and automobile use discouraged.
- The campus layout was designed to discourage the use of motorised transport and to facilitate pedestrian movement. So staff housing, for example, has been located at the periphery to limit the ingress of cars inside the campus.
- However, this goal has proved elusive. Many faculty and staff drive cars or motorbikes the short distance from the housing to the Academic Complex, making it necessary to provide additional space for these cars to park. In part the intense heat forces them to drive this short distance.
- A car-free campus also means that an alternative system of transportation has to be provided to take care of the needs of young children, seniors, and the physically challenged. An electric rickshaw route was established,



Root Zone Treatment system, where *Canna indica* plant roots absorb pollutants from effluent, as part of sewage treatment process

but these rickshaws required heavy maintenance and hence were discontinued. An alternative green transportation mode is provided by two CNG-based vans that drive several times a day between the housing block and the Academic Complex.

- It remains a challenge to encourage staff and faculty to widely use the vans, or to walk or ride bicycles the relatively short distance between the housing and the campus. Once more of the landscape trees have grown up it is hoped that they will shade the walkways enough that the walk between housing and the academic area will not be seen as too arduous.



Explaining the solar carport



Parking in carport

Potable Tap Water

- The campus has its own central water treatment facility that treats the fresh water coming from the Narmada Canal and then distributes the water to the housing, hostel and Academic Complex buildings. This water is regularly tested and is pure enough, after its initial treatment, to be used for drinking water throughout campus.

Generating and Using Power

- All the buildings in the Academic Complex (except for Building 7 which has a shaded terrace) have been designed to house solar photovoltaic panels. The campus currently has a total energy demand of 1000 kWp.
- A solar carport has been built between the student hostels and the Academic Complex. Perhaps the first of its kind facility in the region, the solar panels provide shade from the intense heat in the summer and generate an estimated 190 kWp of power. The rooftop solar panels along with the solar carport together generate an estimated 500 kWp during peak hours.
- While the total generating capacity of solar panels is half the campus demand, the actual power generated by both the rooftop panels and the carport panels typically meets about 15%-20% of the current campus energy demand. This is due to the fact that during off-peak hours and night time the solar panels generate reduced and no power, respectively.
- IITGN was successful in its argument to the Gujarat Electricity Regulatory Commission to have the power company bill the housing units at the residential rate, rather than the commercial rate used for the rest of



Water Treatment Plant

the campus. The power company was at first reluctant to install 270 separate connections, with the resulting smaller transformers. So to help reduce the cumbersome billing associated with so many separate connections, IITGN pays the combined bill for the 270 units to the power company directly and bills each of the units separately for its power usage.

- All the residential buildings have solar water heaters installed on their rooftops. The Housing area has 90 solar hot water units (three per building), each with a capacity of 500 litres per day. The Hostel area has 44 solar hot water units. The Hostel units each have electrical backup, set on timers, to provide additional heating for three hours in the morning and three hours in the evenings.
- LED lights are used in many locations throughout campus. All the road and pathway lights are LED and 74% of the parcel lights are LED. All internal light fixtures in the Academic Complex are LED, except for some special lighting in the auditoriums and some common areas.



Solar water heater on housing rooftop

Ride a Bike

- IITGN encourages the use of bikes on campus, and has developed several initiatives to promote their use. There is a Sustainable Cycle Pooling Initiative for students, staff and faculty. These bikes are available from the security guard at one of the hostels, where the key can be obtained from the guard (one cycle per ID card). These bikes can be used for a maximum of 3 hours, with a fine levied for every 1-hour delay after that.
- Old bicycles left behind by graduating students were refurbished and used for this initiative.
- A bike sharing initiative was started on a trial basis in January 2018 with 25 Mybyk bicycles and 160 OFO bicycles inside the campus. Operated through phone apps that students and staff had to download, during the trial period the bikes were free to use by any IITGN community member. At the end of the trial period IITGN staff evaluated the success of the sharing programme and decided it was not a good fit for the campus.
- A bike sharing programme is soon to be underway. The Institute is in the process of purchasing 200 bikes that will be placed around campus and made available for students, faculty and staff for use.



Bicycles are used to get around campus

Organic Farm

Spearheaded by a passionate volunteer, an organic farm was established on the lot across the road from the staff and faculty housing. This farm provides fresh produce throughout much of the year, making it available through a farm stand on campus several days a week.



7

Promoting Ownership in the New Campus

Stakeholders Involved in Design

- There was a purposeful decision taken from the beginning of campus development to involve all the stakeholders as active participants in the design process. This created a feeling of ownership and responsibility on the part of those engaged in the campus development process.
- When the housing was being designed for staff and faculty, IITGN representatives thought that senior faculty would prefer stand-alone bungalows. The master planners suggested there might not be enough land for this and proposed 3 and 4 bedroom apartments. IITGN reached out to some faculty and their families to ask about preferences. Most people agreed that they did not need bungalows, and in fact they felt 4 bedroom apartments would be too big. Most preferred living closer together, in apartment blocks, with some additional amenities. The final design for senior faculty was 3 bedroom apartments.
- During the design of the hostels, some of the students who were staying in apartments or on the VGEC campus in Chandkheda visited another IIT for a competition, where they stayed in very small rooms. They realised they did not like these 1-seated rooms and preferred slightly larger rooms even if it meant sharing with more students. At that point it was not possible to modify the design of the Phase I hostels, but 3-seated rooms were incorporated in the design for the Phase II hostels.
- Based on the experience of some of the older IITs, IITGN



Faculty and staff housing

knew that they might be expected to accommodate more students than in the original plan. Thus they also asked the architects to design the rooms so that if an additional bed became necessary it would be possible. This meant siting the doors, windows, and closets in such a way that additional furniture could be accommodated

- A unique feature of the hostels is the name of each. As part of the identification of the campus as a non-conforming, thought-provoking institution, the students and faculty decided it would be appropriate to come up with new words, rather than use existing words. They identified several design objectives for choosing hostel names including new words that don't mean anything, simple to remember, no cultural affiliations, able to write names comfortably in devanagari script, and they should form an alphabetical series to assist in wayfinding. So the names of the current hostels start with the letters A—F. As more hostels are built, additional names will build from this.

Residential Campus

- Its design as a residential campus is one of the core features of the IITGN campus. All students are expected to live in the hostels, and 80% of the faculty and 50% of the staff live in the housing blocks.
- Closer academic and social interaction between students and faculty and staff is possible because they are living close together.

Overview of Housing Complex



Gathering Spaces

- The campus has multiple spaces that have been designed to encourage formal and informal gatherings and social interaction. In the housing area there are covered community pavilions, located in the centers of the lawn areas, as gathering spaces. The lobby areas in the apartment clusters also have built-in seating, providing a unique gathering space for residents and visitors.
- The Panchayat Circle is at the center of the student hostels, a place where students can gather informally, but where the entire IITGN community is also often invited for special talks, music, and performances.
- A stronger community spirit results from these easier and more informal exchanges.



Celebration at Panchayat circle

Student-run Activities

- Students have organised many events and celebrations, starting in 2010 when they were located at the VGEC campus. Bringing these traditions with them to the new campus, students organise more than fifteen annual events, celebrations and festivals. All involve participation from faculty and staff as well as the students.



Student celebration in hostel area

Campus Development and Management Awards

- One strategy used by IITGN to encourage ownership and pride in the new campus is the creation of Campus Development Awards. This is a series of awards that are given each year to individuals who were particularly instrumental in playing a role in campus growth, from managing infrastructure, to developing the organic garden, to providing food for the students or guests, to photographing campus events, to developing programmes for construction workers' children, to cleaning and gardening. These awards bring recognition to all the important steps required to construct, operate and maintain a university campus.
- These cash awards are funded partly from the interest paid on the cash awards IITGN received over the years for its campus.





NYASA classroom currently



NYASA classroom during construction

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Fostering Social Responsibility

IITGN has developed several initiatives demonstrating their leadership in social responsibility, engaging with the surrounding local communities as well as the construction workers on campus.

Educational Initiative—NYASA

- Beginning with the location of the temporary IITGN campus on the grounds of the VGEC campus and the construction of some temporary buildings to use for offices and classrooms, the IITGN community acknowledged their responsibility to improve the working and living conditions of construction workers and their families. Typically construction workers have poor working conditions, build ramshackle housing on roadsides by the construction sites and have no place to leave their children while they are at work. It is common practice for workers to carry infant children and toddlers to the work site and to leave them nearby. And, if the families have migrated to the region for work their older children, who would otherwise attend a local school in their villages, lose the opportunity to be part of a school.
- Given this situation, an educational engagement programme, NYASA, was developed with the enthusiastic participation of student and staff IITGN volunteers. IITGN's collective strength in education was used as a platform to bring the children to an informal school, both at the temporary campus and the Palaj permanent campus.



NYASA students

- This initiative provided the children with quality education and entertainment while their parents were at work. During the first phase of construction, this school provided services to nearly 200 children of about 2000 construction workers.
- To cater to the very young, IITGN also established a crèche facility at the Palaj campus, which was overseen in collaboration with the construction agencies.
- Lack of time for students and staff and familiarity with the Gujarati language proved to be a challenge. To help with these challenges, IITGN hired local manpower and initially reached out to a Government education programme, Sarva Shiksha Abhiyan (SSA) for assistance with providing mid-day meals that lasted for a limited period. The core funding for the educational initiative is always paid for through contributions from the IITGN community and well-wishers.
- For the general wellbeing of the construction workers, security staff and the neighbouring villagers, the NYASA team organises an annual 'Sanjeevani: two-day medical camp' where people are given suitable medical advice and medication on routine health issues.

NYASA Cultural and Sports Engagement Programme

- In addition to the educational and health initiative, construction workers' children are also given opportunities to participate in a variety of extracurricular activities involving culture, arts, and sports along with staff and students at IITGN.
- To celebrate the childrens' often forgotten birthdays, students at IITGN made a unique annual event to



Sanjeevani medical camp



Birthday celebrations with the Nyasa students

celebrate all the birthdays, with cake-cutting and games.

- Volunteers and construction managers routinely celebrated various festivals including Uttarayan, Diwali and Holi with the children.

Bada Khana

A 'Bada Khana' was arranged in celebration of the new campus, still in various stages of completion on May 2, 2015. The Bada Khana (meaning big meal) was meant for all members of the IITGN community, including construction workers, and their families, construction contractors and the project management team, so as to share a meal together. It was the Institute's way to acknowledge the contributions of construction workers. As the second phase of construction took off, another 'Bada Khana' was organised on 26 January, 2019 (the Republic Day) where all construction workers, their families and the entire Institute community shared a meal together.



Bada Khana in 2015



Bada Khana in 2019

Seminars on Campus Development

A number of Campus Development Seminars were organised over the years, with participation from the engineering teams of CPWD and IWD, architects, consultants, contractors, as well as other stakeholders. The intent has been to celebrate their work, create pride in the project, and build morale. The seminars were followed by a dinner with the entire team.

The first such seminar was organised on March 28 2013, to share the design of the campus master plan and various buildings before the construction began. Members of the Board of Governors and the Building and Works Committee, many well-wishers including officials of the Government of Gujarat, faculty, staff and students participated. The architects made presentations on their work and sought suggestions.

While the construction work was at its peak, on June 24 2014, a seminar on “IIT Gandhinagar Campus Development and Confined Masonry Construction Technology” was organized in a local hotel. Presentations were made on the masterplan, on confined masonry construction, and on initiatives towards the welfare of construction workers and their children.

To pause after the first set of construction and reflect on successes and lessons before the next set of construction began, another seminar was held on Feb 01, 2017. It was also an opportunity to acknowledge and celebrate the dedicated engagement and significant involvement of various stakeholders including the Building and Works Committee members, architects, CPWD engineers, contractors, various consultants, faculty, staff, students, and well-wishers who contributed at various stages. The first “Campus Development Awards” were given to several individuals who exhibited extraordinary commitment to the development and

maintenance of the campus and to the quality of life on campus. The Director General of CPWD was the Chief Guest on the occasion.

While the work on the second phase of construction was peaking, on April 18, 2019, the Institute organised a “Decennial Seminar” to celebrate the 50th meeting of the Building and Works Committee of the Institute. BWC members shared their perceptions and experiences. The guests included two retired Director Generals of CPWD (Shri Ashok Khurana and Shri Abhay Sinha) who had each been intimately engaged with the Institute while in service, as well as the current Special Director General of CPWD.



First Seminar on March 28, 2013



Decennial Seminar on April 18, 2019



The Institute's Construction Workers Welfare Programme was recognised with the national Housing and Urban Development Corporation (HUDCO) Award for 'Best Practices to Improve the Living Environment 2013-14'

Housing for Construction Workers

- IITGN is committed to providing decent housing for migrant construction workers for the duration of their work. In order to make this a reality IITGN included special conditions in all the contracts issued by CPWD for the Institute. The contractors are responsible for building housing for their workers (and removing such housing after the construction is complete) on land that IITGN provides. IITGN is one of the few large project owners where such conditions have been required.
- CPWD leadership for this project enthusiastically embraced this commitment. It was the first time in most of their long careers where such a requirement was imposed by the client on the contractors.
- This commitment is carrying through to Phase II where the five contractors are all providing appropriate housing with all the basic amenities. For housing located on IITGN land the Institute agreed to pipe in gas for cooking, using its own resources.
- Typical language from a tender document for worker housing stated that "The bidder shall construct clean, hygienic and well-ventilated workers' housing as per the drawings enclosed in tender document, with adequate water supply, electrical and sanitation facilities. No payment shall be made for construction of labour housing". A penalty was imposed on contractors who failed to provide housing for specified number of workers within a specified period of the start date of Rs. 10,000 per day until the housing was provided to the satisfaction of the Engineer-in-Charge.



Women construction workers with hard hats and safety vests

Construction Worker Safety

- The Institute also undertook special initiatives for construction worker safety and welfare, through policy decisions and construction rules. IITGN required the contractors to ensure worker safety, including providing 16 hours of mandatory safety training.
- All the construction workers and contractors were required to follow all safety norms, including adopting safe construction practices and using appropriate safety equipment, including hard hats, throughout the duration of construction.
- The contractors, including the subcontractors, were required to provide comprehensive group insurance of Rs 50,000 for workers and Rs 1,00,000 for supervisory staff.
- This is one of the first known examples of an Institute having such a major role in construction worker welfare. It presented new challenges for the IITGN community as well as CPWD and the various contractors.
- Similar requirements have been put into place for the Phase II elements of the campus.

The IIT Council resolution on construction workers

The Council of IITs in its 47th meeting held on 16 September, 2013 decided as follows:

The work done by IIT Gandhinagar was appreciated, wherein the CPWD contractor mandatorily provides for basic safety and welfare measures, including residential facilities, crèches, monitoring of the payment of dues/ just wages, grievance redressal mechanism etc. The exemplary practices of IIT Gandhinagar should be introduced in all IITs and be shared on the IIT Council Website.



India is a relatively young independent country, with a population of more than 1.3 billion people. Her challenges are enormous, as are her possibilities. It is a responsibility of institutions such as the IITs to provide a physical environment that encourages creative problem solving at a scale that matches India's potential. To build the first phase of IITGN, from agricultural fields to a functioning vibrant academic campus in a few-year span, has been a unique and humbling experience.

There have been many successes as well as trials, all requiring the collaboration, commitment and enthusiastic problem-solving skills of every member of the IITGN family. It is a journey that is not complete, but I feel confident that a solid path forward has been established. As the campus continues to grow in terms of students, faculty, buildings, and reputation, the construction experience during the first phase will provide a strong foundation for future development.

--Sudhir K Jain, Director

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*Credits***Owner****Indian Institute of Technology Gandhinagar**

Advisor Works

Mr Nagaraja B. N. (up to 30-04-2013)

Mr L. P. Srivastava (from 06-05-2013)

Owner's Architect

Ar Shobhit Tayal, Design and Planning Counsel Pvt. Ltd., Ahmedabad

Owner's Engineer

Mr A. K. Kothari, Superintending Engineer (up to 28-01-2013)

Mr G. C. Chaudhary, Superintending Engineer (from 04-02-2014)

Master Planner**M/s Green Campus Development Consortium, New Delhi**

A consortium of Space Design Consultants, New Delhi and Upalghosh Associates, New Delhi

Project Leader

Dr. Vinod Gupta, Space Design Consultants, New Delhi

Urban Designer

Mr. Ujan Ghosh, Upalghosh Associates, New Delhi

Landscape Design

Prof Mohammad Shaheer, MSYK Design, New Delhi

Plumbing

Mr. Mukesh Asija, Krim Engineering Services Pvt. Ltd., New Delhi

Electrical

Mr. Harsha Kumar Anne, Electrical Consulting Engineers, New Delhi

Thermal Design

Mr. Sameer Divekar, DbHMS Consultants Pvt. Ltd., Noida

Infrastructure Consultant**M/s HCP Design, Planning and Management Pvt. Ltd**

Water, Sewage & Road

M/s Multi Media Consultants Pvt. Ltd.

Mr. Apurva Parikh, Director, Multi Media Consultants Pvt. Ltd.

Sewage Treatment Plant

Consortium for Dewats Dissemination Society (CDDS)

Mr. Satchit Bhandarkar, Regional Coordinator, CDD Society

Landscape Architect

Landscape Design

M/s MSYK Design, New Delhi

Prof Mohammad Shaheer, MSYK Design, New Delhi

Mr. Yogesh Kapoor, MSYK Design, New Delhi

Signage Designer

M/s Tata Elxsi, Pune

Mr. Yogesh Dandekar, Senior Manager, Industrial Design

Mr. Amit Ambekar, Lead Designer, Industrial Design

Academic Area Architect

Principal Architects

Mr. Madhav Hundekar and Mr. Vikram Hundekar

Structural Consultant

M/s Shrikhande Consultants Pvt. Ltd., Mumbai

M/s Strudcom Consultants Pvt. Ltd., Pune

BoQ & Tendering Consultant

M/s Shrikhande Consultants Pvt. Ltd., Mumbai

MEP Consultant

M/s Jhaveri Associates, Ahmedabad

Passive Cooling Strategy Consultant

M/s Dbhms Consultants Pvt. Ltd., Noida

Landscape Consultant

M/s Swati Sahasrabudhe, Pune

Lighting & Energy Studies

Mr. Kanchan Sarbhukan, Pune

Acoustic Consultant

M/s Vijay Purandare and Associates, Pune

Housing Architect

Principal Architects

Mr. Rajiv Kathpalia and Mr. Sonke Hoof

Structural Consultant

M/s N K Shah Consulting Engineers, Ahmedabad

MEP Consultant

M/s Jhaveri Associates, Ahmedabad

Landscape Consultant

M/s Iora Studio, Ahmedabad

Hostels Architect

M/s HCP Design, Planning and Management Pvt. Ltd., Ahmedabad

Principal Architect	Mr. Bobby Desai
Structural Consultant	M/s N K Shah Consulting Engineers, Ahmedabad
MEP Consultant	M/s Jhaveri Associates, Ahmedabad
Kitchen Consultant	M/s Kitchen Solutions, Mumbai
Passive Cooling Consultant	M/s dbHMS Consultants Pvt. Ltd., Noida

Confined Masonry

Consultants	Prof Durgesh C Rai, IIT Kanpur Prof Svetalna Brzev, British Columbia Institute of Technology, Vancouver, Canada
Peer Review	Prof Indrajit Ghosh, Civil Engineering, IIT Gandhinagar Prof Dhiman Basu, Civil Engineering, IIT Gandhinagar
Project Management	Central Public Works Department (CPWD), Government of India
Project Manager	Mr. L. K. Bhargava, Superintending Engineer (up to 29-01-2016) Mr. Kapil Deo Narayan, Superintending Engineer (from 29-01-2016)

Building & Works Committee

Indian Institute of Technology Gandhinagar

Chairman	Prof Sudhir K. Jain, Director, IITGN (2009-present)
Members	Prof Neelkanth Chhaya, Former Dean, Faculty of Architecture, CEPT University, Ahmedabad (2009 - present) Shri Kiran S. Wagh, Chief Advisor (Civil Infrastructure), IIT Bombay (2009 - present) Shri R. Subramanian, Former Additional Director-General, CPWD, New Delhi (2009 - 2012) Chief Engineer (Capital), Roads & Buildings Dept, Government of Gujarat, Ahmedabad (2009-2012) Director (TS-I), Ministry of Human Resource Development Government of India, New Delhi (2009 - 2011) Shri A. K. Jain, Former Special Director General, CPWD New Delhi (2012 - present)

	Shri L. P. Srivastava, Former Additional Director General, CPWD & Advisor (Works), IITGN (2012 - present)
	Prof Ashwini Kumar, Professor-in-Charge, Planning & Resources, IITGN (2012 - 2014)
	Prof Harish P. M., Dean (Campus Development), IITGN (2014 – August 2018)
	Prof Gaurav Srivastava, Dean (Campus Development), IITGN (Sept. 2018 - present)
	Dr. Prabhat Kumar, Former CMD, Bharatiya Nabhikiya Vidyut Nigam Ltd, Kalpakkam, (2012 - 2016)
	Shri M. B. Bhalala, Former Chief Engineer, Road & Building Department, Government of Gujarat (2009 - present)
Secretary	Shri B. S. Punalkar, Registrar, IIT Bombay (2009 - 2013)
	Shri P. K. Chopra, Registrar, IITGN (2013 -present)

Project Progress Monitoring Committee Indian Institute of Technology Gandhinagar

Members

Shri L. P. Srivastava, Advisor (Works), IITGN

Shri A. K. Jain, Former Special Director General, CPWD, New Delhi

Shri Kiran S. Wagh, Chief Advisor (Civil Infrastructure), IIT Bombay

Shri Prabhat Kumar, Former CMD, Bharatiya Nabhikiya Vidyut Nigam Ltd, Kalpakkam (up to January 2016)

Shri Balraj Chadha, Chief Engineer, CPWD, Gandhinagar (up to May 2016)

Shri A. K. Agarwal, Chief Engineer, CPWD, Gandhinagar (July 2016 - present)

Shri Laksh Bhargava, Project Manager, CPWD (up to January 2016)

Shri Kapil Deo Narayan, Project Manager, CPWD (up to January 2019)



This publication is one in a series describing the development of IIT Gandhinagar's campus on the bank of the Sabarmati River in Gandhinagar. The campus development provided numerous opportunities for innovation and the series is meant to document these.

The focus of this document is summarising the innovations and challenges that arose in the construction of Phase IA of the campus. These ranged from: understanding the physical planning fundamentals, as envisioned by the master planners; planning and managing a complex construction project; the challenges presented by the harsh climate; the role of water in campus development; the steps taken to design a green campus; design features to promote ownership in the campus; and initiatives to foster social responsibility.

Copies can be obtained by writing to the librarian@iitgn.ac.in



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