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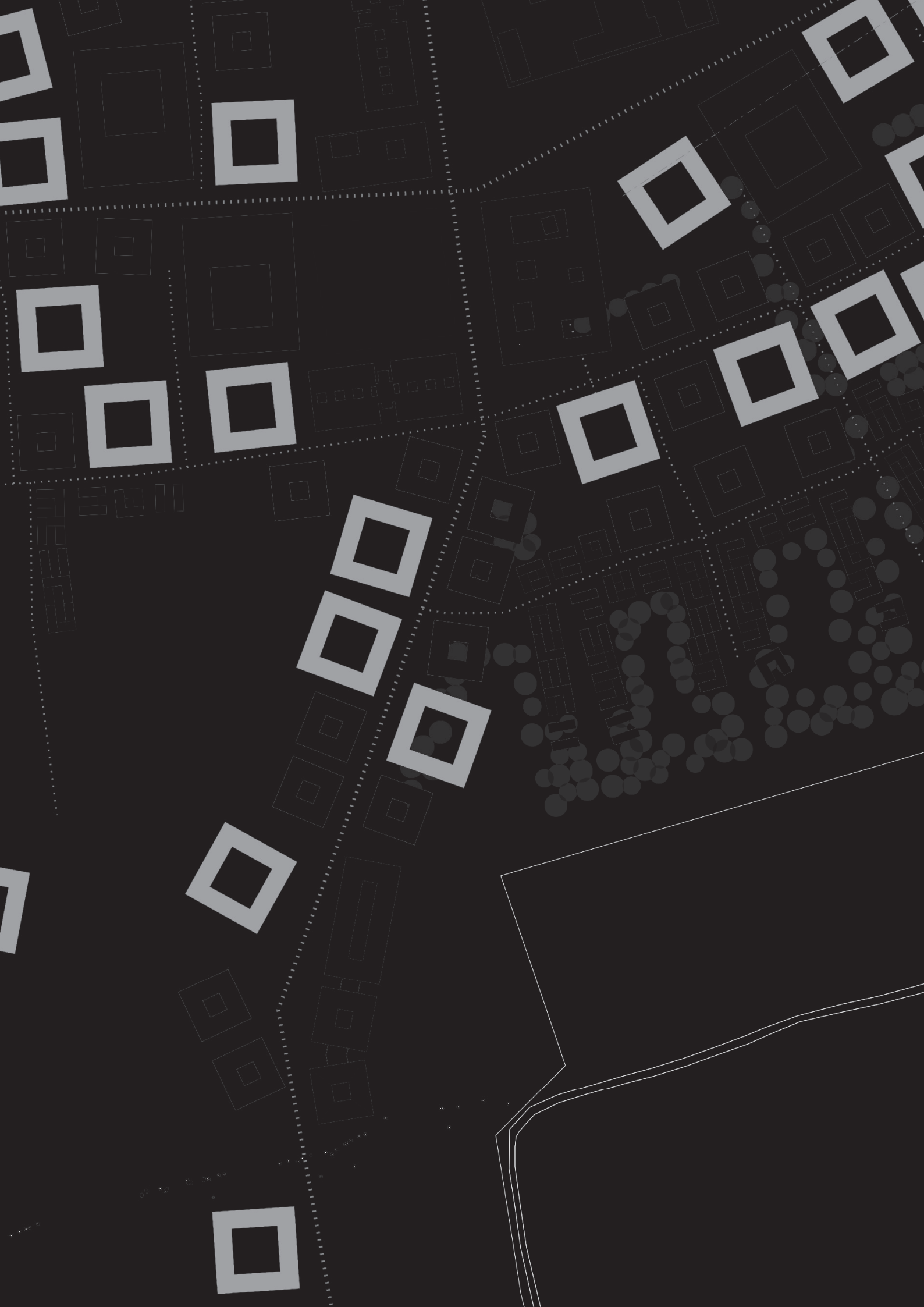
Architectural Design Competition
for
Nalanda University Campus
Master Plan and Phase I Construction

REPORT ON ARCHITECTURAL DESIGN AND ESTIMATES



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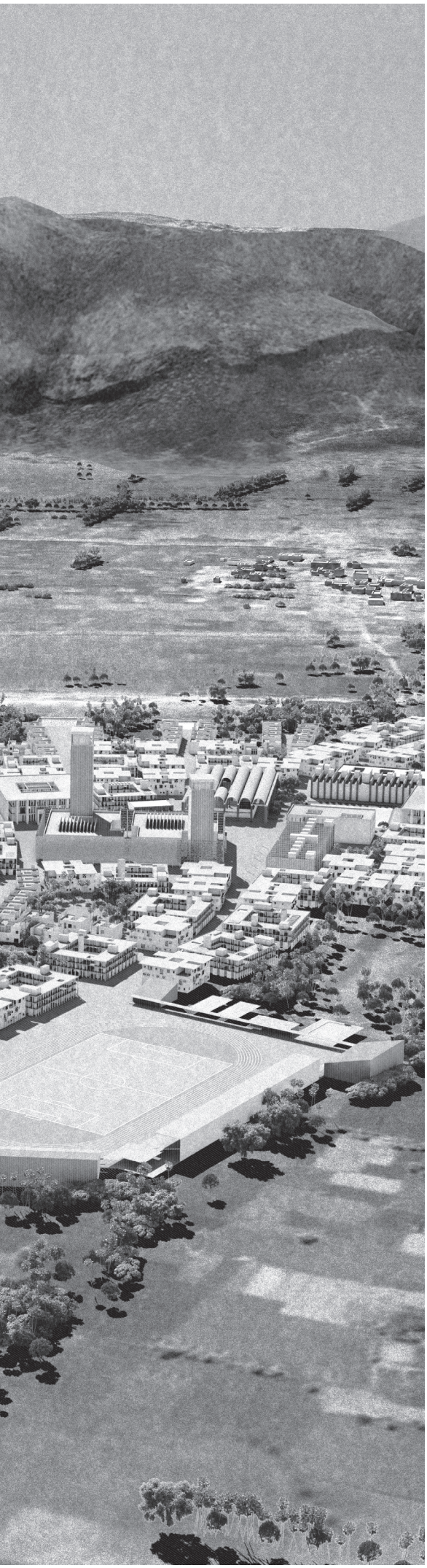


INTRODUCTION

The great universities of the world are wonderful places. They provide all the advantages of normality within an urban structure that is a special and memorable place. As part of a town, they avoid becoming hermetic and institutional and instead enjoy a reciprocity of influence between what they need to be and the place and context in which they find themselves.

They work best as places to study in when they are a part of a normal urban fabric - where day to day things happen, where interactions are serendipitous and where the pattern of uses are complex. Their whole is greater than the sum of their parts.

Our proposal seeks to make the University of Nalanda both practical and memorable. Practical because the buildings are simply constructed, straightforward in their planning and flexible in their use. And memorable not because the buildings are iconic architectural statements, but because the spaces between them are interesting, rewarding and legible.

This network of spaces will reflect the plan of a town. A comfortable series of interlinked spaces will provide an urban pattern with a relaxed permeability and a clear hierarchy. A series of pedestrian routes will link every building and lead to directly to a primary street in which the major university activities are located. At one end is the library, the food court, the campus inn, the international centre, the administrative building and the faculty of historical studies, at the other, the museum and auditorium and a temple.

This is a plan that will have seemingly grown organically and yet it is a plan that is quite deliberate. Its central spine is a busy pedestrian street - its east-west alignment running parallel to the more distant topography of the escarpment to the north. This dramatic landscape becomes a constant reference as it is seen as the backdrop to all of the routes that link the residential and the teaching spaces which run perpendicular to the main street.

The landscape, the informal plan, the natural hierarchy, and the pattern of simply-planned buildings are the elements of a composition that, on the one hand, is inherently flexible and easy to make, but, on the other, has a clear urban pattern and a unique identity.

The plan for the new University will produce a place that facilitates efficient study and research and manages to achieve that within a calm series of spaces that are ordinary when required to be but which together are extraordinarily memorable.

SITE AND MASTERPLAN

UNDERSTANDING THE PLACE

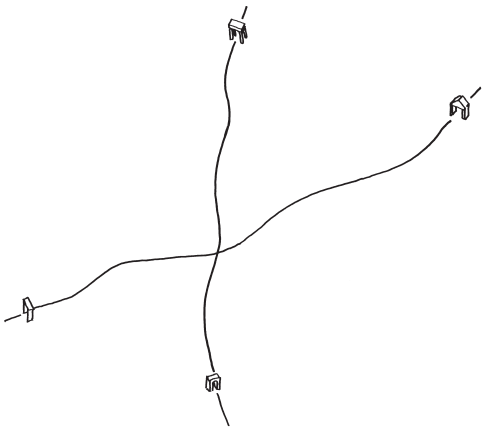
Our approach starts with an understanding of the site, both in physical and cultural terms. Our proposal for the Nalanda University Campus aims to a site specific response that creates a strong link with the place and the illustrious history of the ancient ruins.

The first step has been to analyse the different components the site.

One of the most impressive aspects is the constant and distant presence of the Rajgir Hills to the South of the site. They give a natural backdrop to the campus and we have decisively orientated the campus with the mountains in mind. The presence of the mountains counterbalances the relatively flatness of the site. The use of the site for cultivation in the past gives the plot an open field feel with few scattered trees.

The whole site is surrounded by a concrete compound wall that establishes a very strong limit with the surrounds. Beyond the walls there are several small villages that show the traditional configuration of the unplanned and spontaneous settlements of the area. Also towards the South there is the train line connecting to the city of Patna. The presence of the train line could play an important role in the future of the University Campus. Finally, towards the East there is the city of Rajgir, which is the main urban centre in the vicinity.

OUR IDEAS



Crossroads and Gates

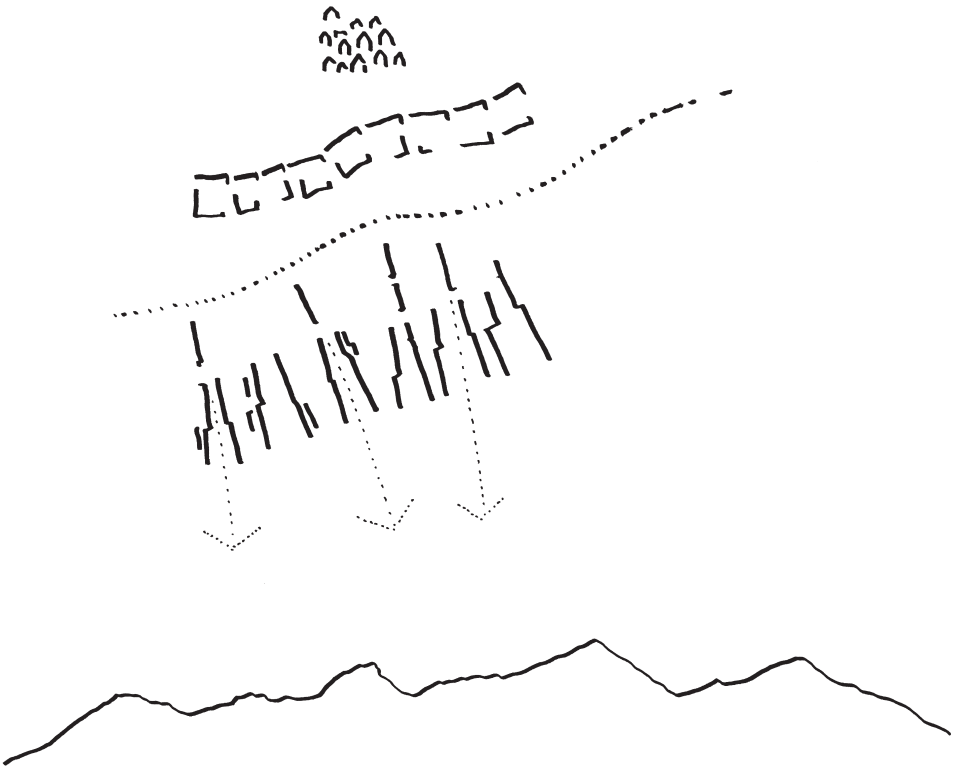
The origin of cities was often the cross road between trading routes. The meeting point in many cases evolved to become a central gathering point, with a series of key buildings assembled around some sort of open space. The original cross road has in many towns a symbolic charge linked to the foundation of the settlement.

In the same vein, as cities evolved the need of protection from the outside threats lead to the construction of protective walls which define the clear limits of the town. The gates in the city walls were key points both in the defence of the city and its relation with the outside world. Whilst walls and gates might not be needed any longer, their symbolic weight is still present in urban culture.

Given the configuration of the site our first instinct has been to establish a system of connections with the immediate context through two main routes: one East – West and another one North – South. These routes organise the movement through the complex both for vehicles and pedestrians. Each route has a different character. The route East – West is understood as the main spine of the University and will be completely pedestrian. The route North – South connects the State Highway 71 with a potential new train station to the South of the plot. As in traditional walled cities, each of the routes will relate to four distinct gates on each side of the site which will serve as the entrance points for the university.

The Asymmetry of the Place

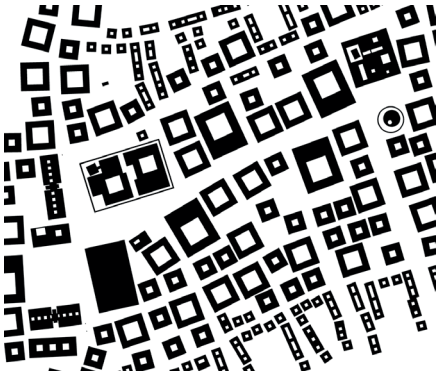
Whilst the site is relatively flat and the vegetation is fairly uniform, the presence of the mountains to the South gives a marked asymmetry to the place. Rather than ignoring this important feature of the site, we have decided to organise the site plan establishing a constant reference to the mountains in the distance. The way in which the North and South edges are treated respond accordingly: the North side is treated as a 'back' with a continuous line of houses and court gardens which will create a buffer between the residential area and the compound wall. The South edge is a more complex border: a series of reservoirs will deal with the water runoff from the mountains during the monsoon months. This will lead to a group of green fingers that open views from the centre of the site to the distant Mountains. The way in which houses and residential accommodation is organised will frame these views and create a sense of openness towards the mountains.



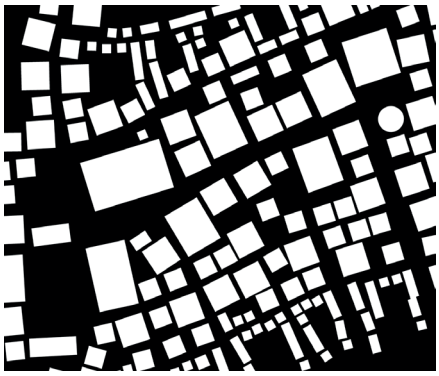
Simple Buildings – Complex Spaces

One key aspect of Indian cities is the relaxed informality of their urbanism. Buildings are placed against each other in an almost casual way giving shape to the most exciting and interesting spaces: little alleys, pocket open spaces, gardens, etc. The space in between building is almost more important than the buildings themselves. However in most cases the character of these spaces is the by-product of unplanned growth over a long period of time. Is it possible to achieve the same character and charm of urban spaces that are the product of years of evolution and changes when building a scheme in one go? Is it possible to plan informality?

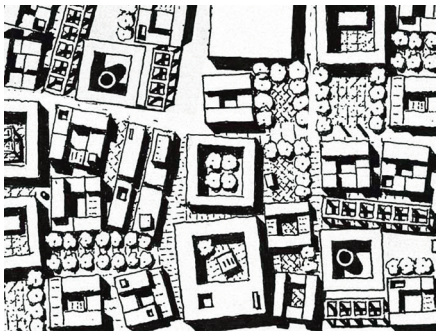
Without aiming to make a caricature of this informality, our proposal aims to reinterpret key aspects of the urban spaces we find in cities on this latitude. Two key decisions have been taken into consideration on this respect: the configuration of the buildings and the shape of the spaces in between.



In order to produce rational and flexible buildings that will stand the test of time, we have aimed to keep them as simple as possible. With some few exceptions all buildings are conceived as straightforward rectangle volumes changing in length and depth to accommodate the different types of accommodation. The few buildings that do not follow these rules are either special pieces (like the school) or the uses imply a particular form (like the sport facilities). The simple form of the buildings allows for efficient floor plans.



However, the apparent simplicity of the building shape is used to configure complex public spaces. Whilst the shape of the buildings is pure, the shape of the spaces in between is complex and rich. On this respect, the way in which the buildings are placed on the plot has been carefully composed to give specific form to the spaces in between. On this way a delicate balance is achieved between the desired rationality needed to build a complex project like this and the relaxed character that the public spaces should have.



Density for Place Making

A great deal of the intensity and character of the traditional cities is India is given by their density: the proximity between the buildings produces recognizable urban spaces where multiple uses and buildings contribute to shape distinct places. Density is the by product of many different reasons: the value of the land, the forms of inhabitation, the response of the climate or the forms of property. We believe in the positive aspects of density to create functional and successful urban places.

As such, our proposal for the Nalanda University Campus has aimed to be as compact and dense as possible. We have tried to make the footprint of the campus as small as possible by locating buildings close together. The intention behind is two folded: one the one hand, it creates a place that could be defined the distance / time of a walk: ten minutes walk from one end to the other. We believe this will give human scale to what is a very substantial complex. On the other hand is the fundamental belief that density is intrinsically linked to sustainability in many different ways, in particular as motor transport will not be required on a day to day travel between buildings. A compact campus will definitely work better than a spread one.

Consequently the campus is organised around a series of free standing buildings which sit close together in a tight web of little alleys, streets and open spaces. The proximity will contribute not only to the definition of the open spaces, but crucially, generates a profusion of shaded open spaces. Furthermore, the proximity between buildings will also enhance the natural ventilation of both the open spaces and the buildings that shape them since the configuration will create natural wind flows. This is enhanced by two design moves. Firstly corridors have rooms to one side only, secondly each building has been designed to allow for omission of individual rooms within the footprint and enhance airflow through it.

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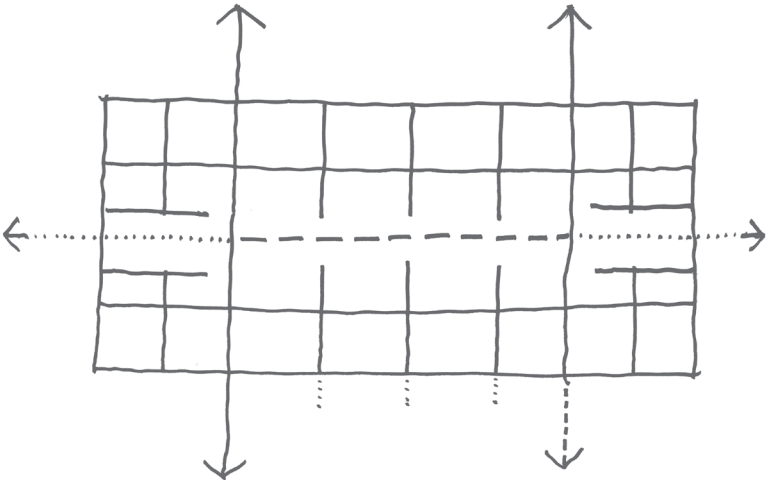
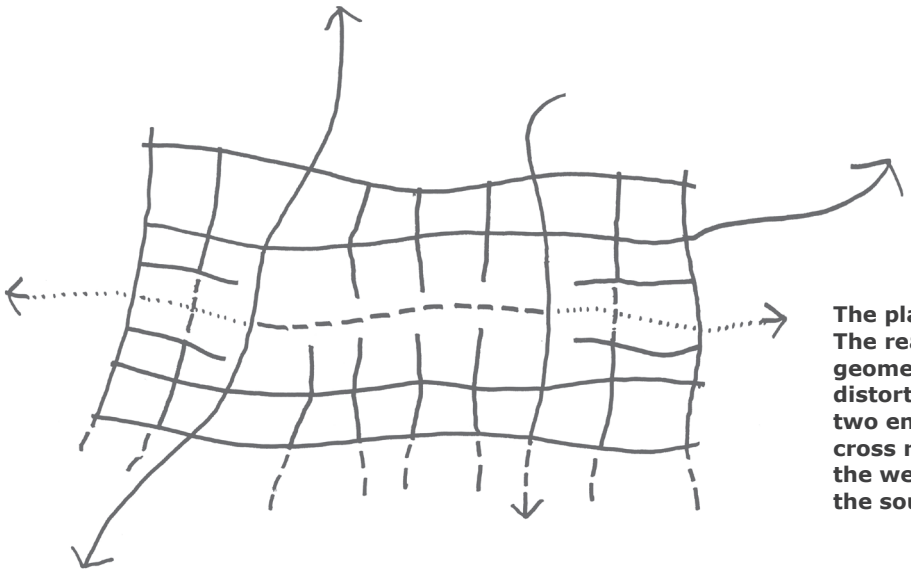


The plan diagram.
A network of roads serves every building. Two parallel east-west roads to both the north and south of the site are linked to provide a continuous circuit. At the heart of the diagram is a pedestrian spine.

2



The plan distorted.
The reality of the site geometry and topography distorts the diagram. The two entrance routes become cross routes - one arriving to the west and the other from the south.

3

The urban diagram.
A series of urban blocks are defined by the street pattern. Spaces begin to emerge which suggest the ends of the pedestrian spine. A distinction emerges between the inner larger, taller blocks and the outer smaller and lower structures.

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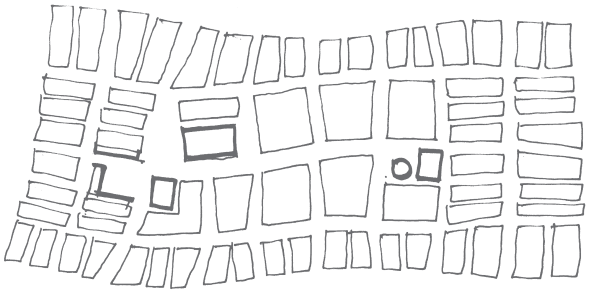

Spatial significance.
The diagram develops to show the major university buildings that are located at either end of the pedestrian spine. These buildings become associated with larger public spaces made possible by the simple omission of a block within the grid.

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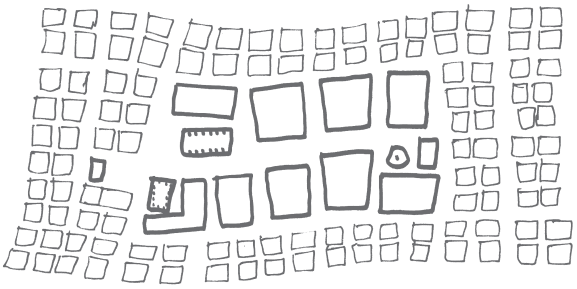

Urban clarity.
The distinction between inner and outer block is further clarified. The integral street pattern is set within a flexible grid that allows change and development to occur.

6

Character. The diagram develops to the point where subtle spatial relationships emerge. The grain of the buildings are located, the hierarchy of the street pattern clarified and the pedestrian spine is defined. The character of the place is set.

7

The masterplan.
The master plan is the simplification of an anticipated urban plan. Here the buildings have been removed as they are essentially flexible. What remains is the space between buildings and the definitions of the significant sites.


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01 Administrative Offices, Estates Management Offices, Security Offices, Student Centre
02 Ecology and Environmental Studies
03 Historical Studies
04 Linguistics and Literature Studies
05 Buddhist Studies, Philosophy and Comparative Religion Studies
06 International Relations and Peace Studies
07 Economics and Management
08 Information Science and Technology Studies
09 Communications Centre, University Systems Centre, Lecture Rooms, Cubicles, Meeting Rooms, AV Room, Faculty Lounge, Tutorial Room
10 Library
11 Integrated School with Creche
12 Faculty Club
13 Campus Inn
14 International Centre
15 Auditorium, Multi Purpose Hall and Art Centre/Museum
16 Sports Centre, Stadium and Sports Fields
17 Medical Centre
18 Dining Hall and Food Court
19 Bank Extn Counter
20 Fire Station
21 Post Office
22 Temple
23 Open Air Theatre
24 Green Houses
25 Farms
26 Energy Centre
27 Water Reservoir
28 Gates

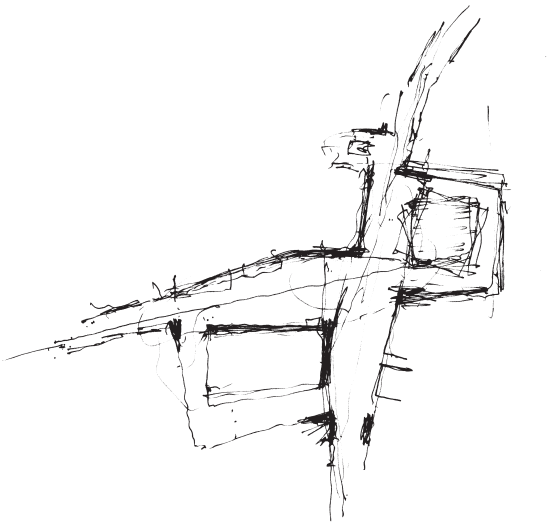
Notes
– Commercial Centre and shops are distributed around campus in individual locations
– Lecture rooms and PhD cubicles have been allocated to individual Faculty Buildings

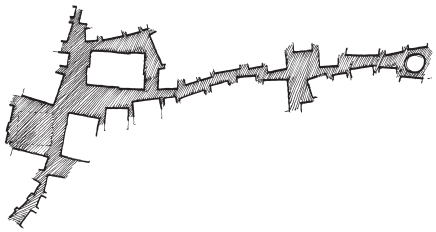
Roads

Vegetation and Water

Buildings

TWO INTERLINKED OPEN SPACES



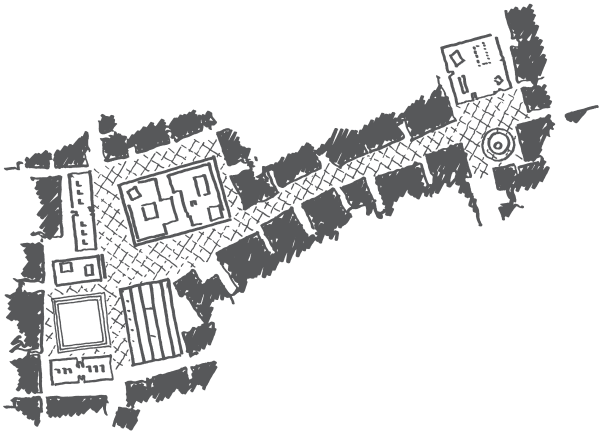


As in traditional cities, the two main open spaces of the Nalanda University Campus are structured around a series of special buildings defining the central gathering places for the complex.

The first space is located at the cross road between the two main routes of the campus. Most of the special buildings will be located here creating the civic centre of the University. A large open space will be defined by the library, the food court, the campus inn, the international centre, the administrative building and the faculty of historical studies. One large water reservoir defines the West side of the open space whilst the East side is defined by the presence of two large public buildings: the library and the food court. These two buildings are intended as the centre pieces of the campus: one is understood as the focus of the knowledge (the library) whereas the other one will be an important gathering place (the food court).

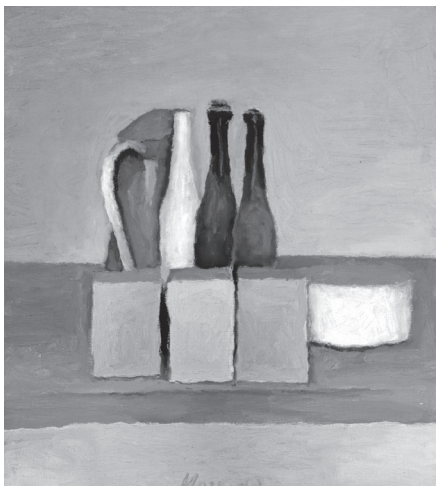
It is important to note that this space will be built in the first phase of construction, giving the complex a recognisable centre from the inception of the University.

The second space is also located onto the main pedestrian spine and it is intended as a counterpoint to the main centre. This space is also defined by some special buildings: the museum and auditorium have been combined into one single building to give them more status. Also temple is proposed in this space. Finally the faculty of Buddhist Studies, Philosophy and Comparative Religion and the bank will be also located here.



BUILDING TYPOLOGY

FAMILY OF BUILDINGS

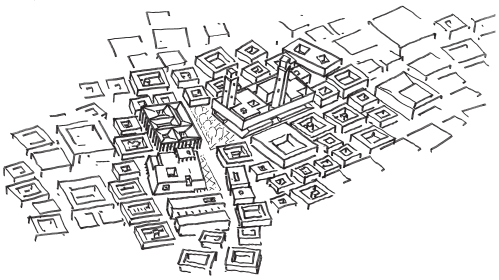


Most of the successful urban spaces in cities around the world show a certain degree of cohesion. Rather than having different types of buildings competing against each other for attention these spaces tend to be an assembled chorus of relatively similar kinds of buildings working well together. The success of these areas seems to derive then from careful control over the typologies used and subtle variations on a few themes.

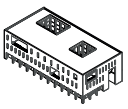
On this respect our proposal for the Nalanda University Campus is organised around a controlled number and types of buildings carefully placed together. Most of the buildings share a number of features: a family of buildings. There are two intentions behind this configuration. On the one hand a group of related objects generate a dynamic interplay between the pieces. Giorgio Morandi's Still Life illustrates perfectly this relationship: the closeness of distinct shapes of bottles or kettles on top of a table, which crucially also highlights the importance of the space in between.

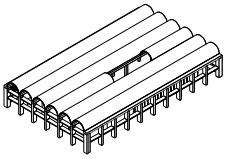
But also the 'familiarity' of the objects is important; the fact that they share some aspects that turn them into a cohesive composition and not a collection of disparate objects. In the same way in which in a family each individual is recognisable but they might share similar traits, the volumes of our proposal aim to create an harmonious family of buildings that work well together but are each one identifiable on its own right.

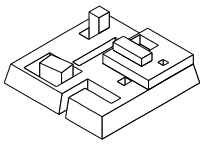
All the buildings in the campus will share at least four different aspects:

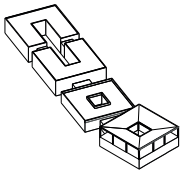


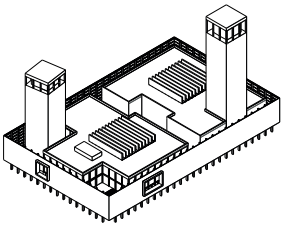
Courtyards Following the lessons from the traditional architecture of the region, all our buildings incorporate courtyards. The use of enclose open space contributes not only to the spatial qualities of the buildings but is an essential measure for the natural ventilation and the environmental strategy.

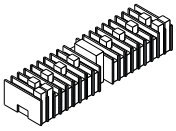


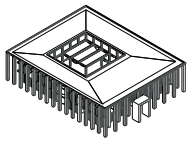








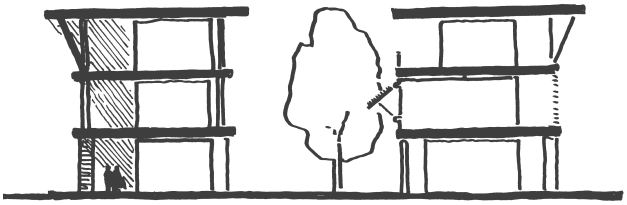




Shading devices In the same vein than the courtyards, different types of shading devices are essential part of the architectural language of all the buildings. The profuse use of shading screens, slab projections, window shutters or simply recessing the envelope will help to provide different degrees of shading at the same time defining the character of the architecture.

Arcades and Routes Through Most of the buildings within the campus with the exception of the individual houses will provide some sort of connection with the public realm. The bigger buildings like the faculties, the special uses or the student residences have arcades in the ground floor providing covered routes. Smaller buildings will also provide routes through their courtyards. This permeability will multiply the ways in which the site will be crossed.

Materiality Finally, all buildings will be built mostly from the same material: brick. This decision has several reasons behind. As is a common in the region, bricks could be easily obtained by digging in the ground. This will provide a locally sourced material which will contribute to the net zero's aspirations for the campus. Having one main material will ease the construction process, allowing the application of similar details and construction techniques throughout the campus. Finally, we also believe the most successful urban complex in the world tend to have a degree on consistency in their materiality that contributes to their identity: Nalanda University Campus will have the redness and earthiness coming from the bricks of the region.



FIGURES AND BACKGROUNDS

The best cities in the world have an urban clarity that does not need any translation to be read and understood. These are places where buildings express their function and role within the urban space, being that the pivotal monuments of temples and town halls or the humble background of individual dwells.

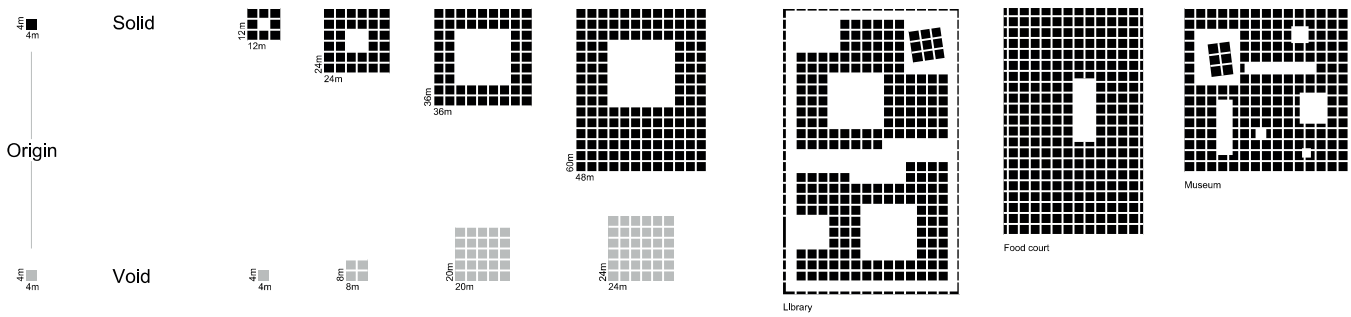
In the same manner than in any opera there is a need for the main figures to be supported by a well assembled chorus, our proposal seeks to establish a carefully organised background around a handful of special buildings. Rather than aiming for every building to be special (which equals that none is) only the singular functions such as the library and the food court will punctuate the more homogenous carpet of more typical and background buildings. The difference between the figures and the background will give identity and orientation to each of the sectors of the campus.

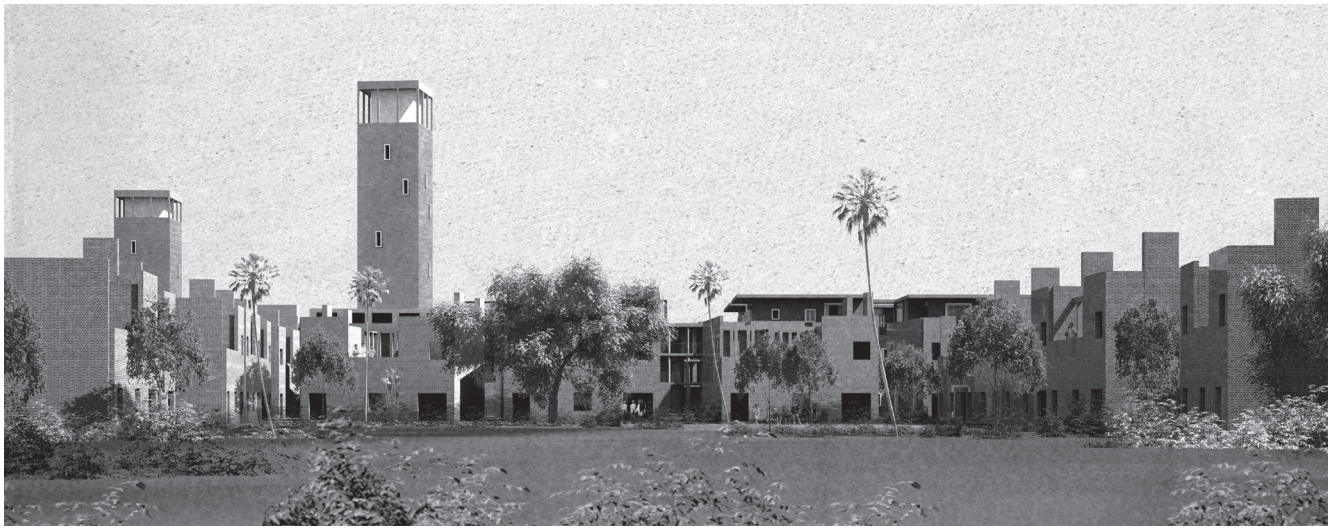
SYSTEM OF RULES

The different degrees of consistency and variation and the delicate balance between figures and background will be underpinned by a simple rule: a numerical one

All buildings have been designed with a straightforward grid of 4 x 4m in mind. This has led to a series of multiple in which every single building is related to others by its proportional rules. The smaller unit (individual houses) is a simple square of 12 x 12m with a central courtyard of 4 x 4m. The next building in the series (block of apartments) is double the size: 24 x 24m with a 8m courtyard. A series of iterations relate one building type to the next one until we get to the biggest one (the library) which is a rectangle of 64 x 104m.

The numerical discipline allows to have a strict degree of control of the different types of buildings without constraining the desired level of variation that a campus this scale should normally have.



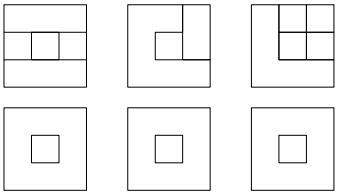


Ground floor plan

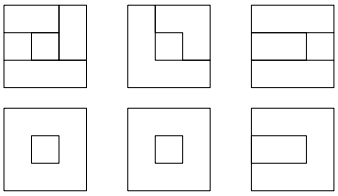
Elevation

VILLAS

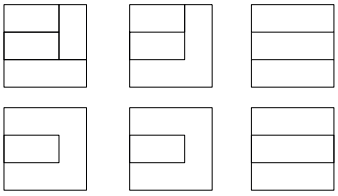
Basic module



220 sqm



200 sqm



185 sqm

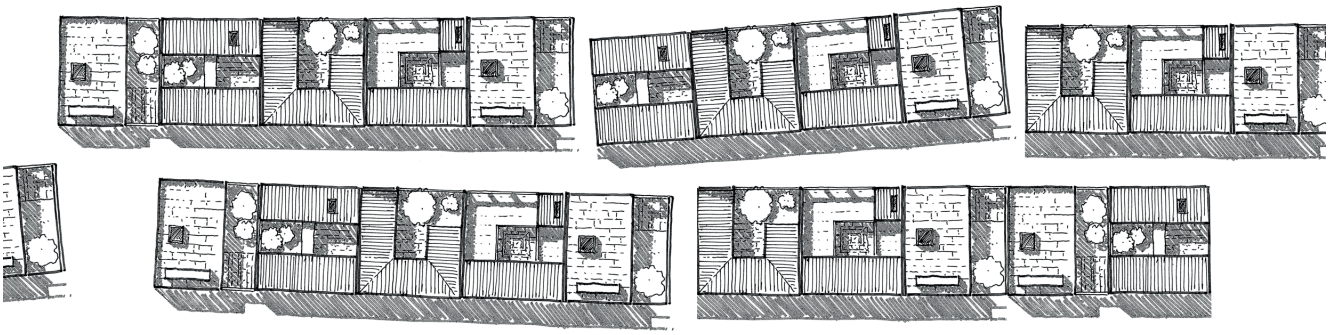
Accommodation for all residences larger than 185 m2 has been designed as single houses, or villas. The layout is based on a 4x4m module, with 3x3 modules on ground and second floor, which leads to a 12x12m large, 2 storey villa. In order to match the required size for each type of residence, modules are then taken out of the base figure. Each Villa has a central courtyard as a minimum (4x4m).

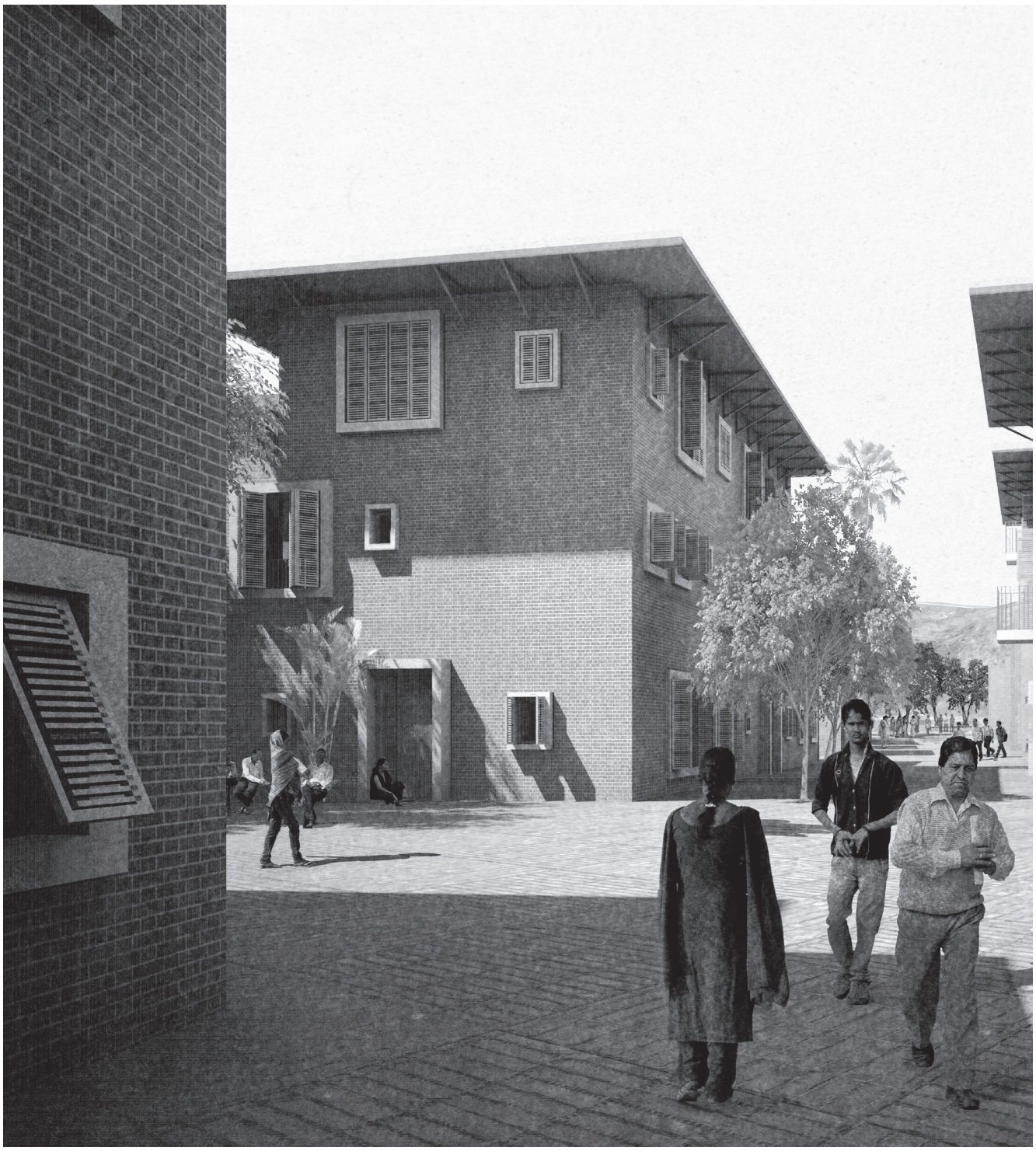
Areas are achieved as follows, based on the 18 modules available:

220sqm = subtract 4 modules
200sqm = subtract 5 modules
185sqm = subtract 6 modules

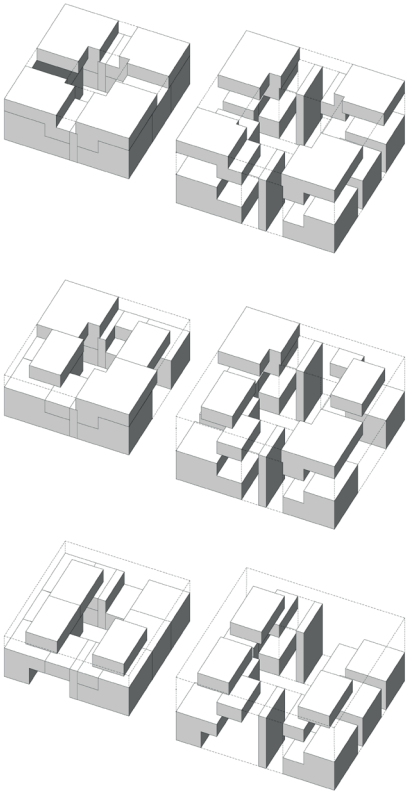
A set of variation has been designed, with some buildings as solitaires, and others arranged as a row of houses with party walls, not exceeding an overall length of 4 buildings to allow for sufficient air flow through the site.

One party wall of each building has been designed as a 'thick' wall, which acts as a services riser and also allows for distribution of pre-cooled air from the basement area of the building. These 'chimneys' have been taken above roof level and form a distinct visual design element. All wet rooms have a window for direct ventilation of moist air.



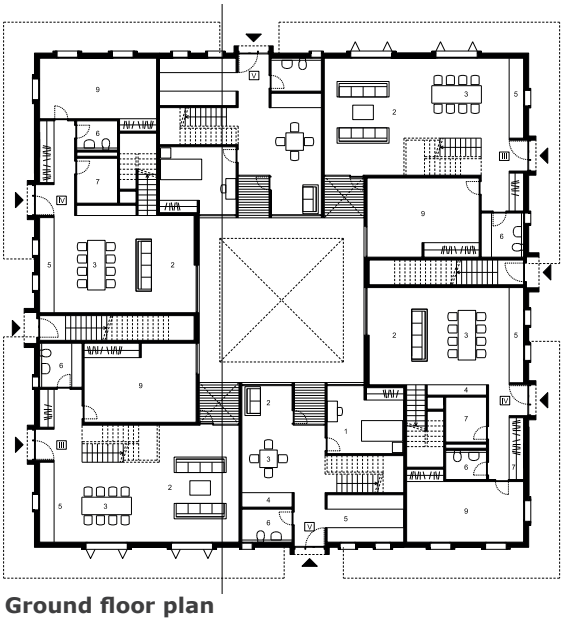


APARTMENT BUILDINGS



Accommodation for all residences between 150 m2 and 130 m2 is located in town houses, with each town house containing between 8 to 10 apartments. The basic size of the apartment buildings is with 24 x 24m twice the size of the villas, with a courtyard of 8x8m.

The key design driver is for each unit to have their own street entrance. All apartments extend over 2 stories and include a private internal stair, which organises the apartment between semi private and private areas. Furthermore every apartment has its own external breakout space, in form of a terrace, balcony, loggia or roof terrace. All rooms are connected to the below ground cool air labyrinth. All wet rooms have a window for direct ventilation of moist air.



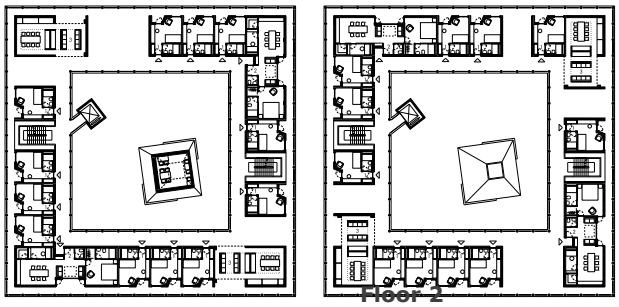
Ground floor plan

Elevation

STUDENT RESIDENCE

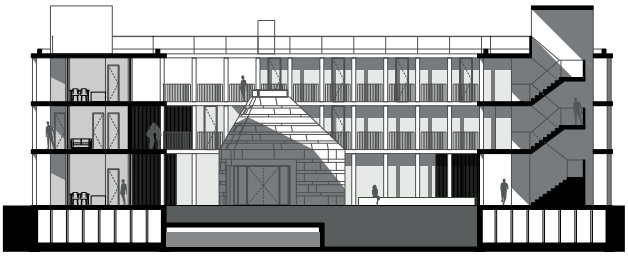
The buildings for students and scholars increase in size again by 12m to an overall size of 36 x 36m and a courtyard of 20 x 20m. All corridors face the courtyard with rooms to one side only to allow for cross ventilation by placing windows to both sides of the rooms. All rooms and apartments (for married scholars) are single storey with common stairs and lifts. The student rooms have been reduced in size slightly, with more areas added to the common facilities to encourage a communal engagement within the building as well as the use of library and faculty buildings to study. The bigger units for married scholars and communal areas occupy typically the corners of the building.

Individual student rooms are left out in different locations of each building to create a variance within this building type across site and encourage airflow through the building. All student residences have the same footprint. There are more units in buildings in vicinity to the central spine of the campus. Buildings become less dense towards the perimeter. All rooms are connected to the below ground cool air labyrinth. All wet rooms have a window for direct ventilation of moist air.

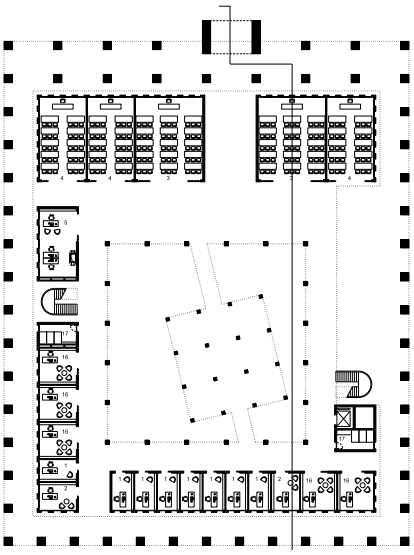


Floor 1

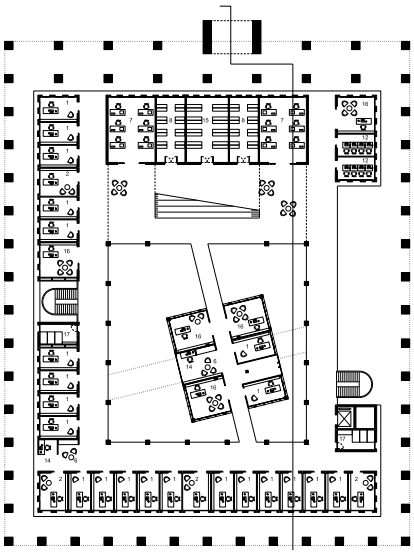
Floor 2



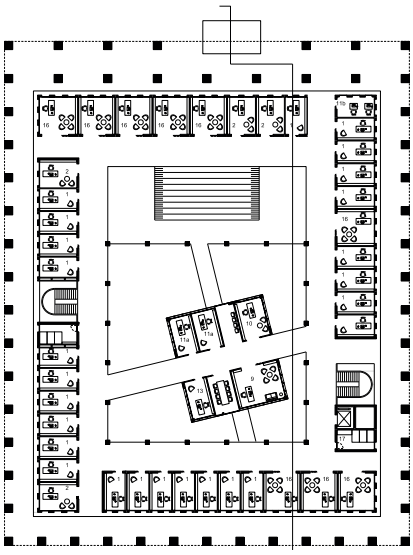
Section



Ground floor



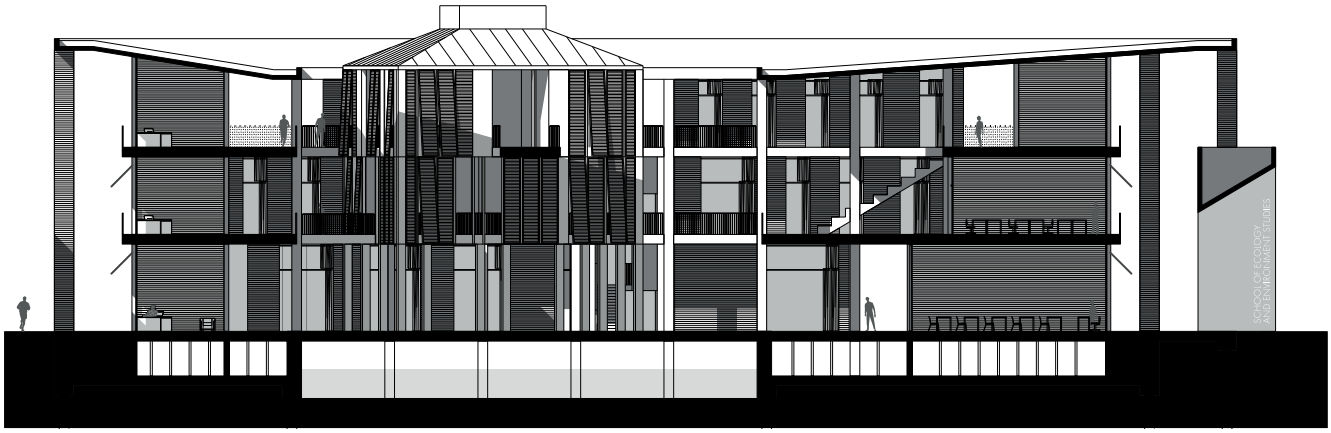
First floor



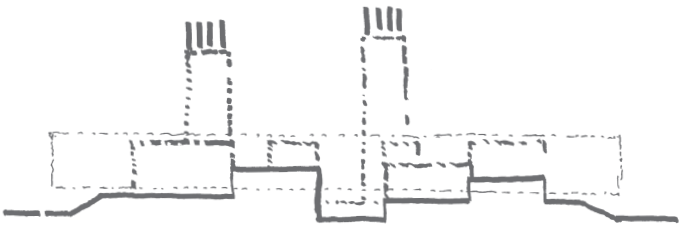
Second floor

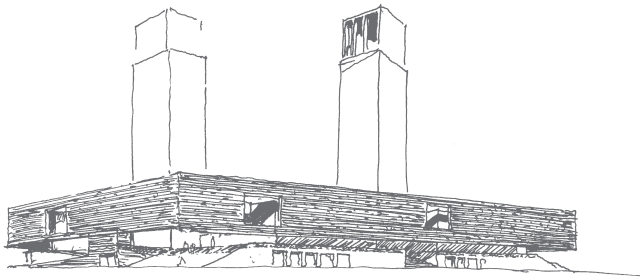
FACULTY BUILDINGS

The seven faculty buildings are located along the length of the central spine, alternating to the left and right when walking along this axis. The buildings are 3 stories tall with lecture rooms and labs towards the public and representative spine. Activities within the individual courtyards differ from calm breakout spaces to lecture rooms and small gathering spaces. Same as the student housing, the corridor is located towards the internal courtyard with rooms to one side only for improved ventilation. All rooms are connected to the below ground cool air labyrinth.



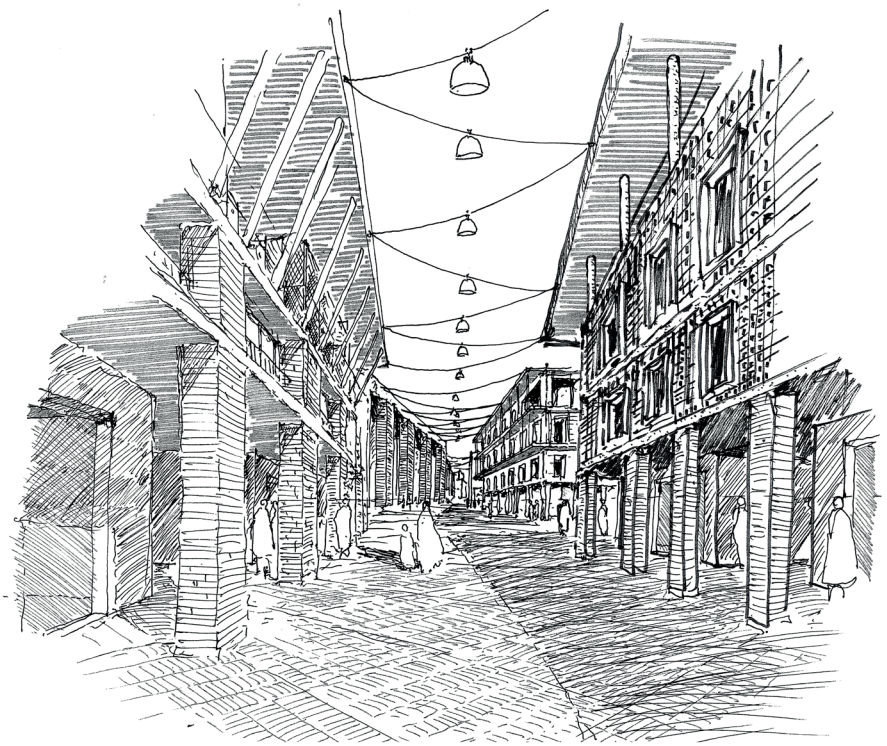
Elevation

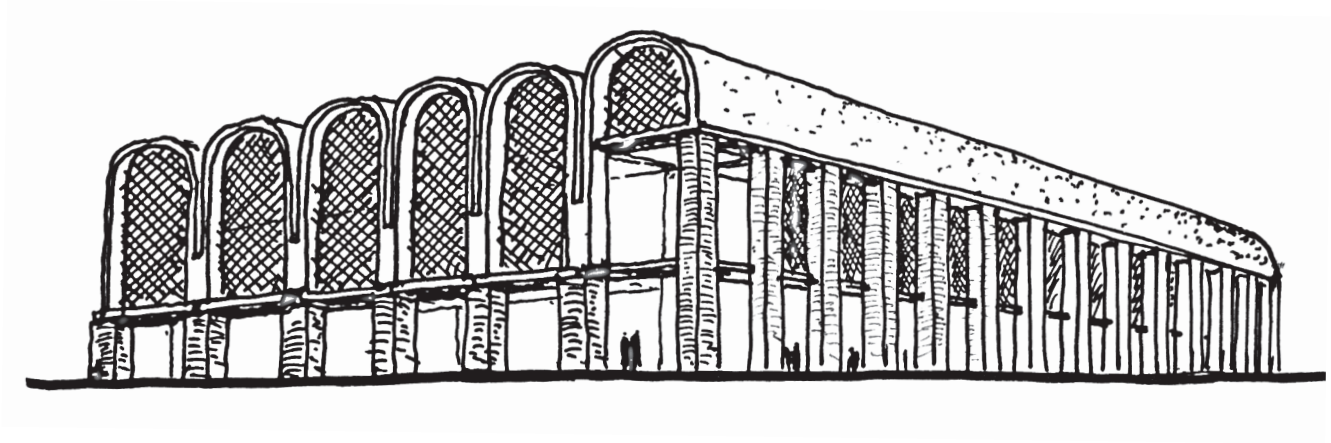


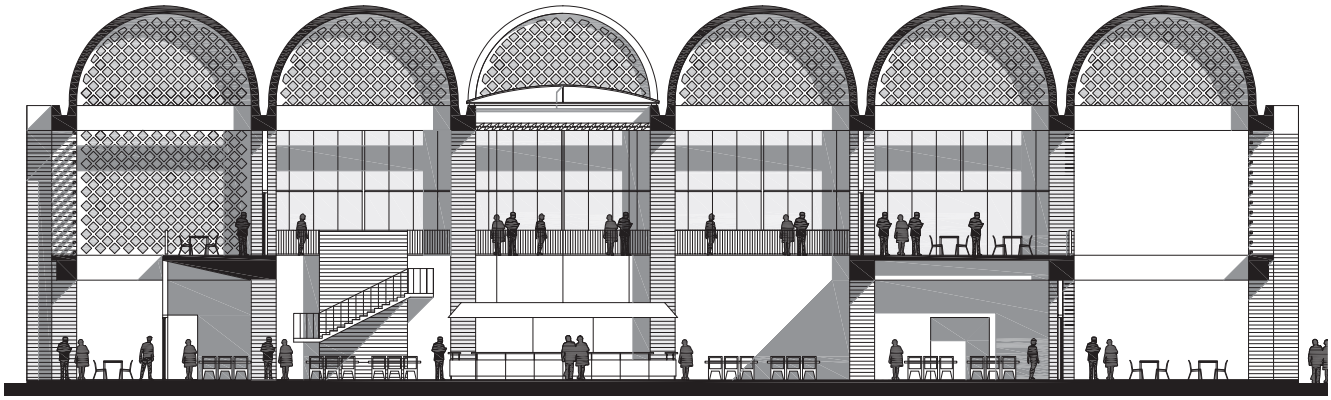


SPECIAL BUILDINGS

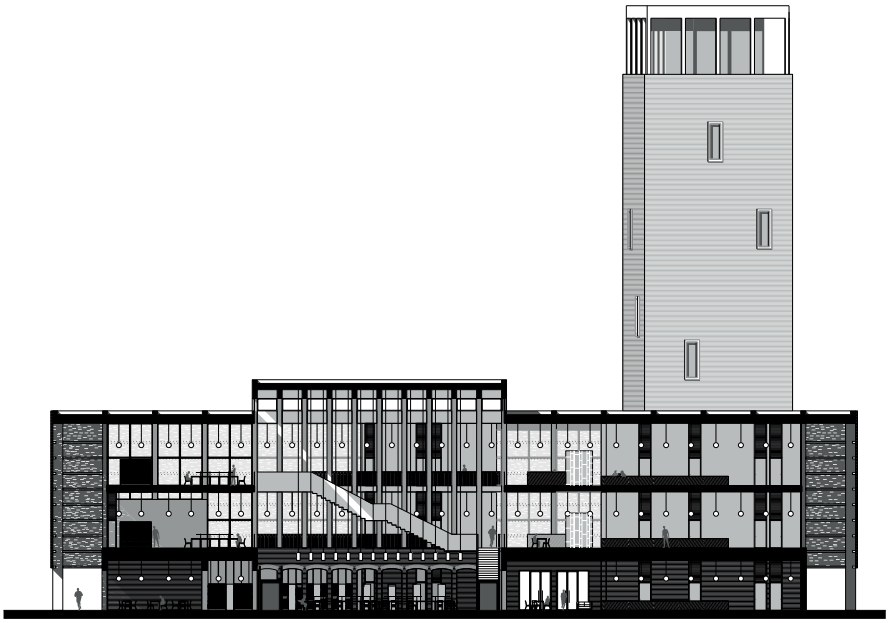
All special buildings are located in three distinct locations within the masterplan. The west plaza of the spine (library, food hall, university administration, bank, campus inn) The east plaza (temple, museum, auditorium) and on each of the 4 roads before entering the village (sports and fire station to the north, faculty club to the west, medical centre to the south and school to the east). While following the principals of geometry of all other buildings, each building is designed distinctively to its function and importance, which adds to the vibrance of the masterplan and sets markers within the overall site. The towers of the library will be the landmark for the campus and be visible from a far distance due to the nature of the flat topography.



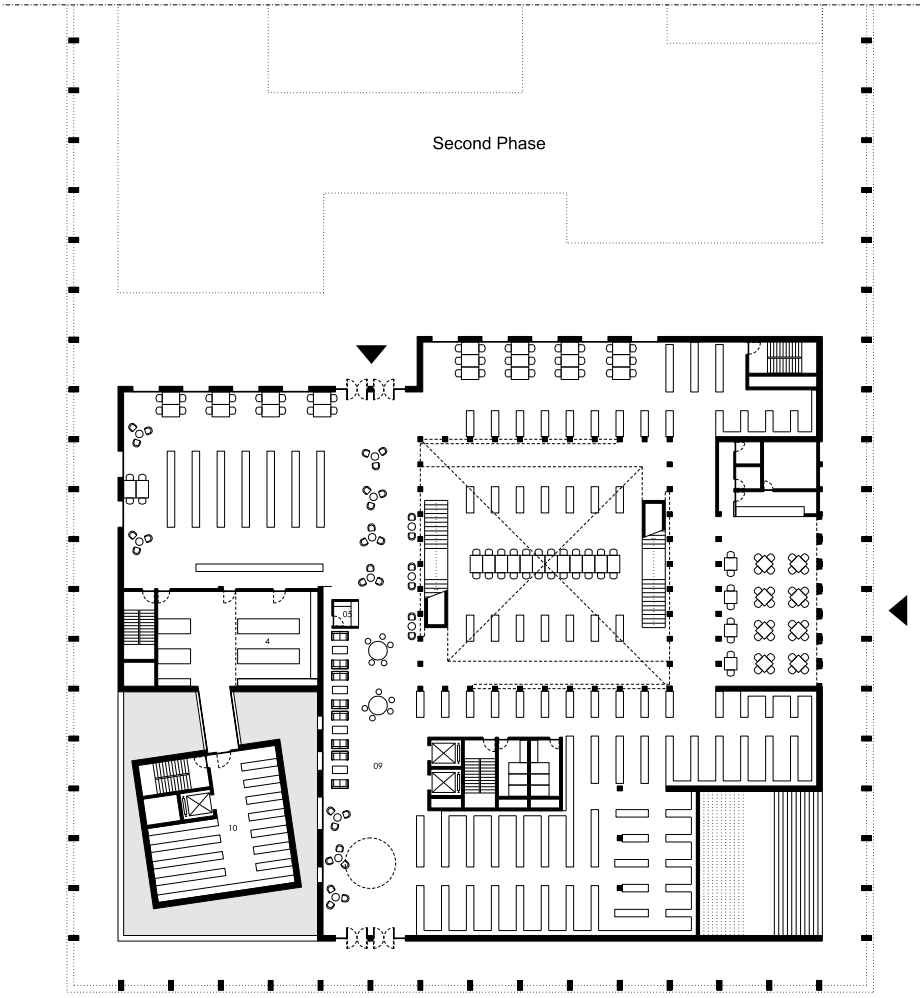




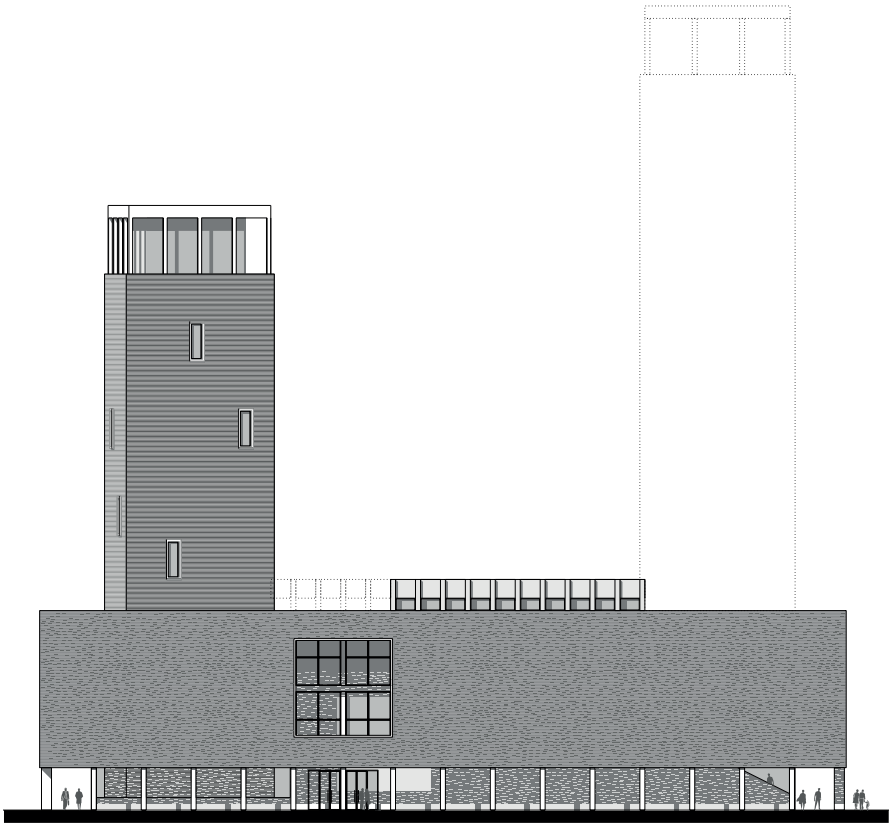
Foot court section



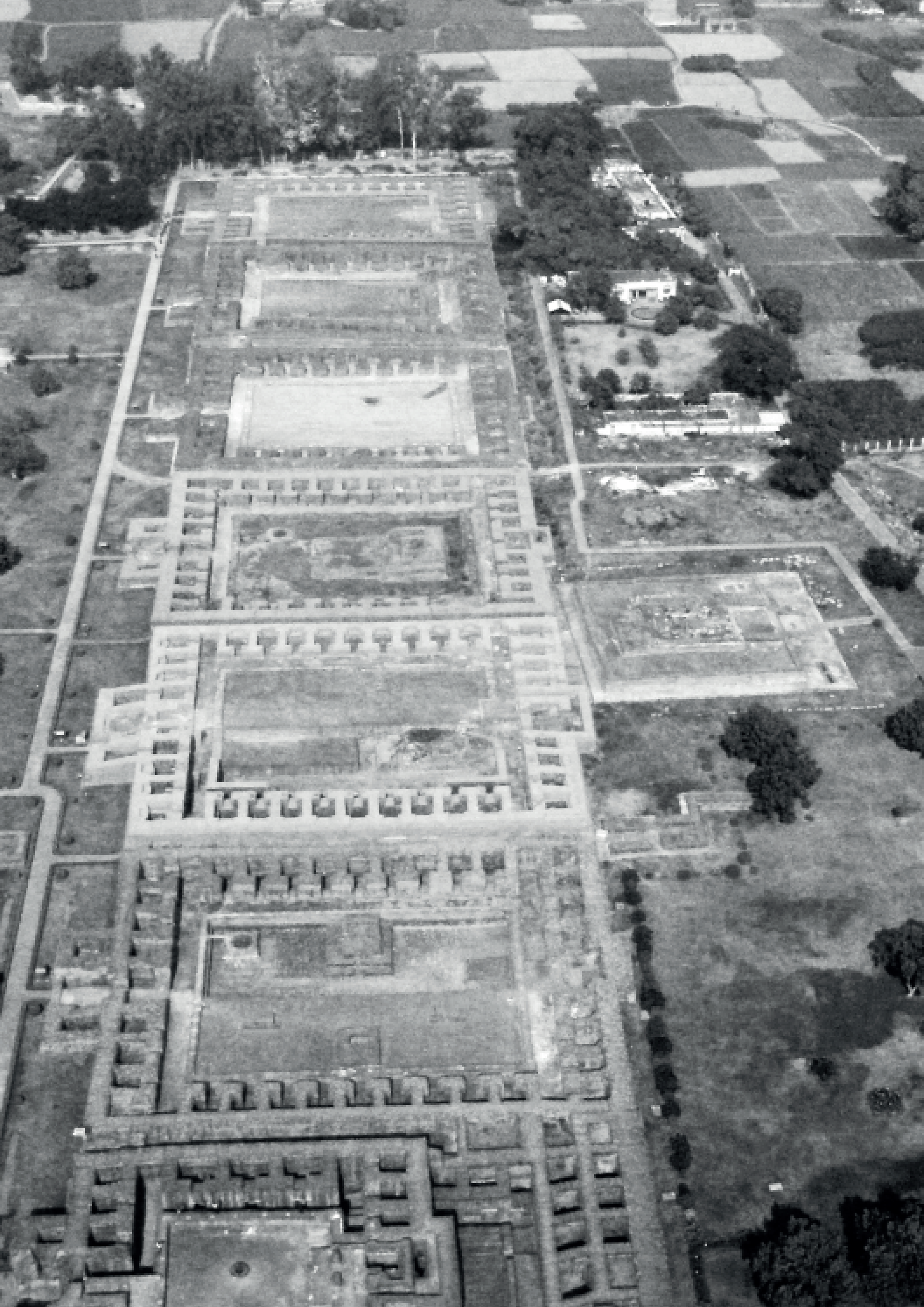
Library section



Library ground floor



Library elevation



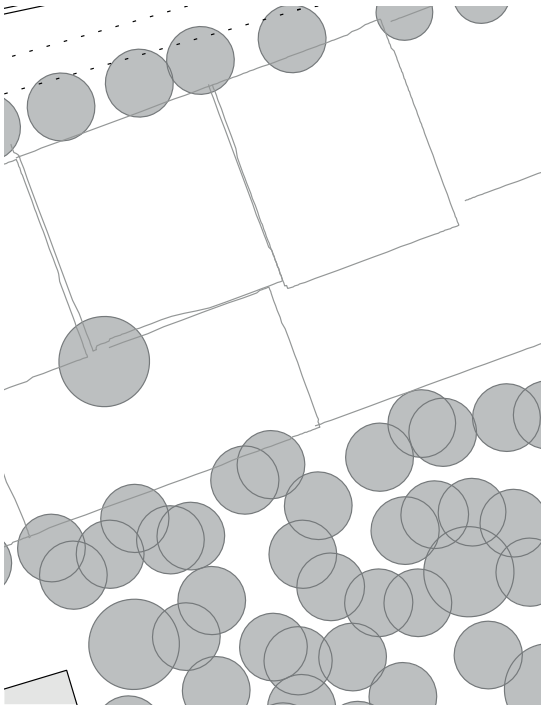
LANDSCAPE

Dealing with a project of this scale implies not only a definition of the built structures that will be placed on site but also what is the nature of the open space. Once again we have looked at the lessons from the traditional Indian architecture, particularly the way in which open space tend to be enclosed or define by different types of edges to create 'open rooms'. Temples, Summer palaces and other civic structures tend to be associated to a series of gardens, stepped water reservoirs or stone plateaus that provides an important reference for our proposal.

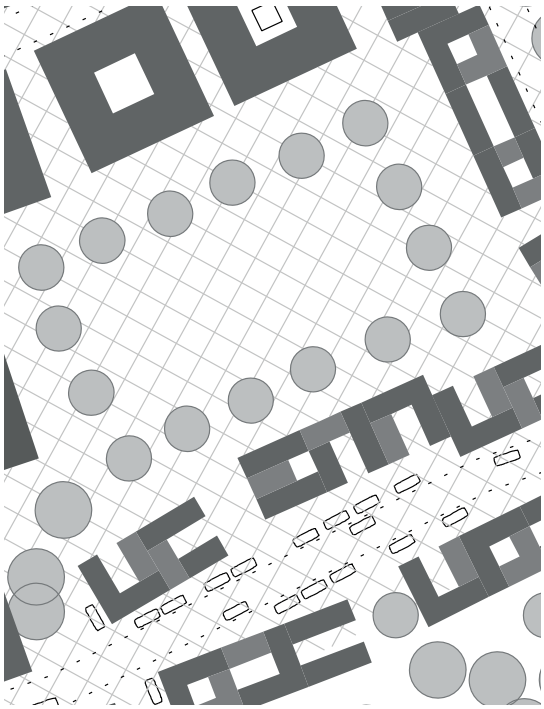
But of equal importance is the notion of the landscape strategy as a tool to define the spaces for the different phases of the project. Strategic planting at the beginning of the planning will allow enjoying mature gardens and shaded open spaces once the buildings are built around them. Defining green courts corridors could start prior to the actual construction, helping to the configuration of the different types of open spaces.

Finally, the definition of the landscape infrastructure is intrinsically linked to the strategy to deal with the water on site. The runoff water coming from the mountains during the monsoon months remains on site for long periods after the rains. Site visits confirmed the need to deal with surface water in an organised manner. On this respect a series of water reservoirs of different scale are strategically located across the site to provide both adequate measures to deal with water and distinct landscape features.

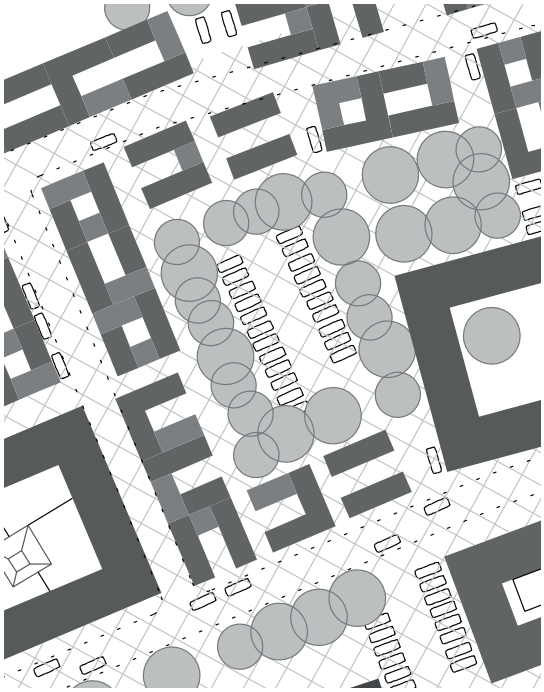
TYPES OF OPEN SPACES



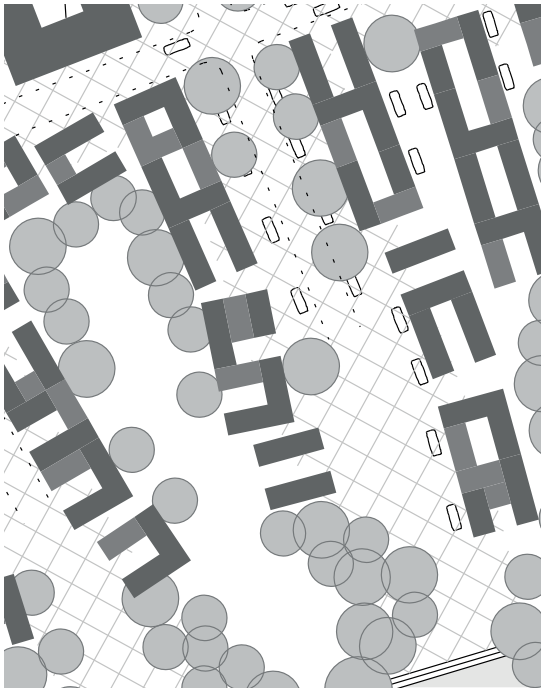
Fields



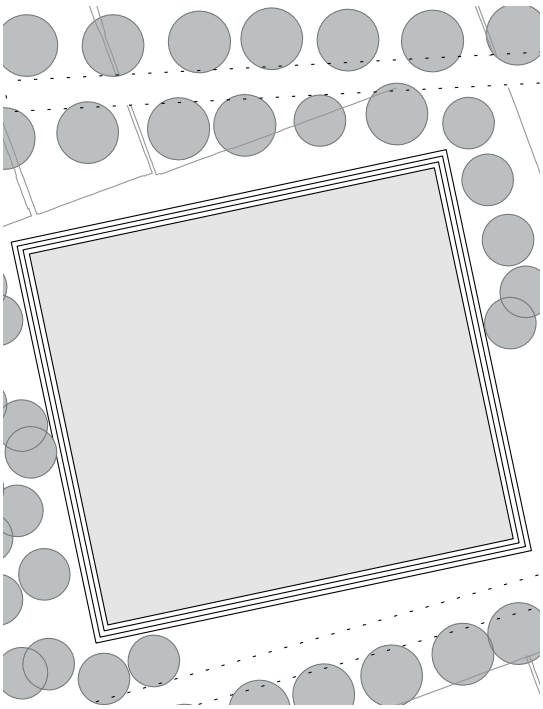
Neighbourhood piazzas



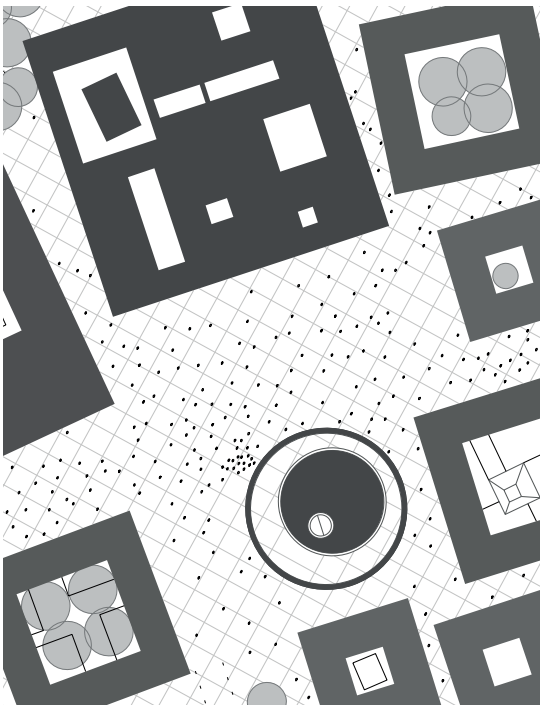
Court gardens



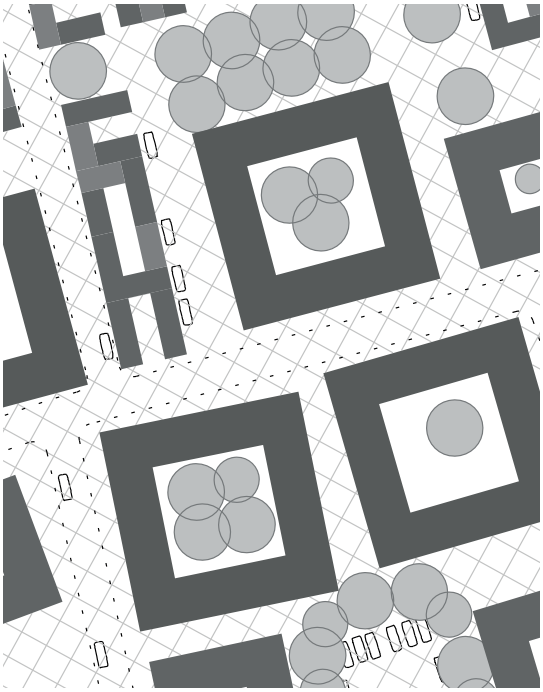
Linear gardens



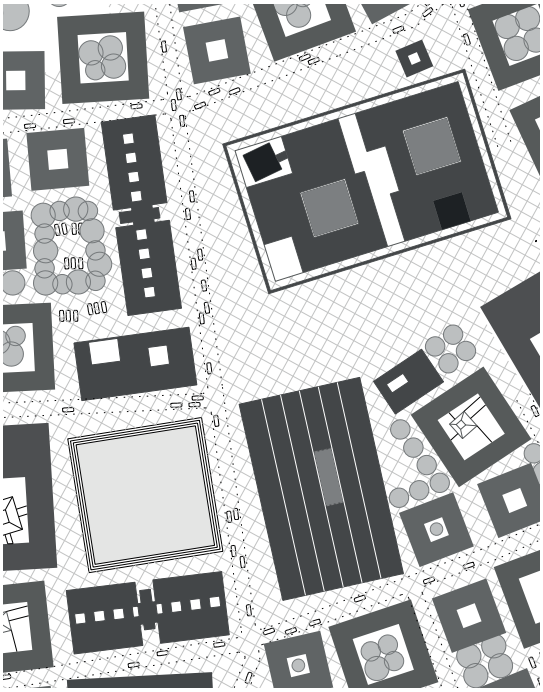
Water reservoirs



Museum square



Internal courtyards



Nalanda University Square

REGIONAL CONTEXT

- Nalanda is a historic site located close to Patna.
- Nalanda is famous all over the world for the ancient international
- Monastic University established in 5th Century BC, which taught Vedas, Logic, Medicine, Meta Physics, Prose Composition and Rhetoric.
  Nalanda District is popularly known as Biharsharif.
- Geographically this was one of the most fertile and populated areas of Eastern India.
- The *University of Nalanda* was built several centuries after the Buddha's passing away. The site, originally a mango grove surrounded by lotus ponds, was a favourite resting spot of the Buddha during his travels.

Topography

The Nalanda District divided in two main parts

- Hills Land of Rajgir and Giriyak
- Cultivated Agriculture Land

Forest

The Nalanda District have total Forest area of 4462 Hectare of 1.91 % of total Georaphical Area. The Forest area mainly situated in Giriyak and Rajgir Blocks.

AGRICULTURAL PATTERN

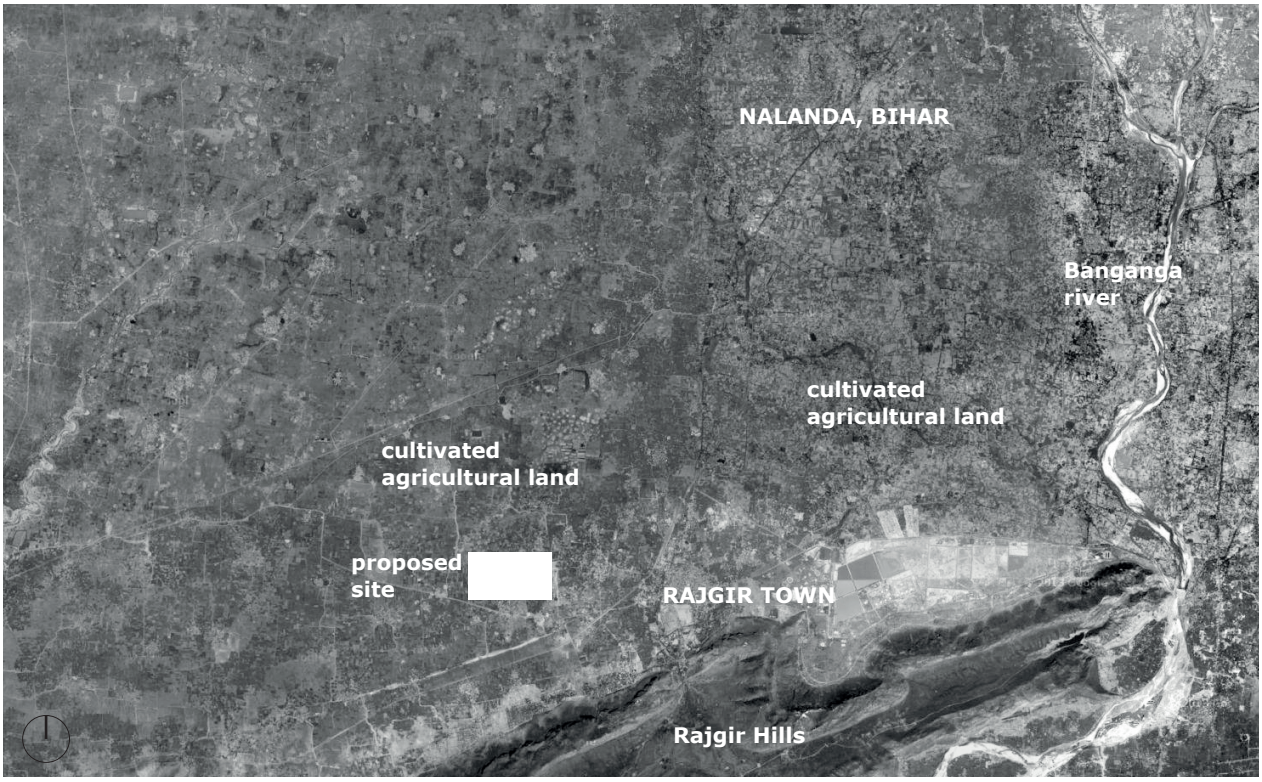
Farmers in this area practiced various rotations during the cropping year. The main rotations were: rice (kharif)/wheat (rabi)/then moong (mung bean, a short-season legume) and finally dhaincha (sesbania) for green manuring, or alternatively, rice/maize/moong/dhaincha.

Farmers in this area practiced various rotations during the cropping year.

Other rotations include:

1 rice/potato/onion
2 rice/lentil/gram; rice/mustard or toria, a rapeseed
3 groundnut/arhar(red gram)
4 maize/red gram intercropping; or some other mixed cropping rotation.

In a few pocket areas, a rotation of rice/potato/muskmelon or watermelon was also raised.



The total site area is 455 acres

SOIL, RAINFALL

The two types of soil prevalent in the region are:

1 Udifluvents

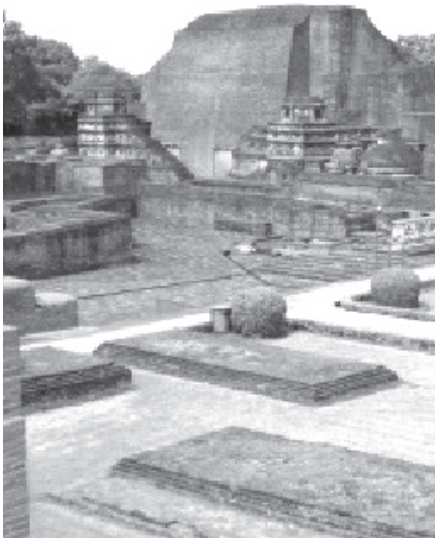
2 Red gravelly soil

Udifluvents are younger alluvial soils which are deficient in nitrogen, phosphoric acid and humus. Texturally these are sandy to loamy sand,

Red gravelly soil have poor fertility and are suitable for high land crops. These are found mostly on the hilly areas in the region. These tend to be acidic in nature and are poor in plant nutrients.

Rainfall

The average annual rainfall of the area is about 900 mm of which nearly 80% occurs during the period June to September. The major part of the monsoon rainfall goes as surface runoff.

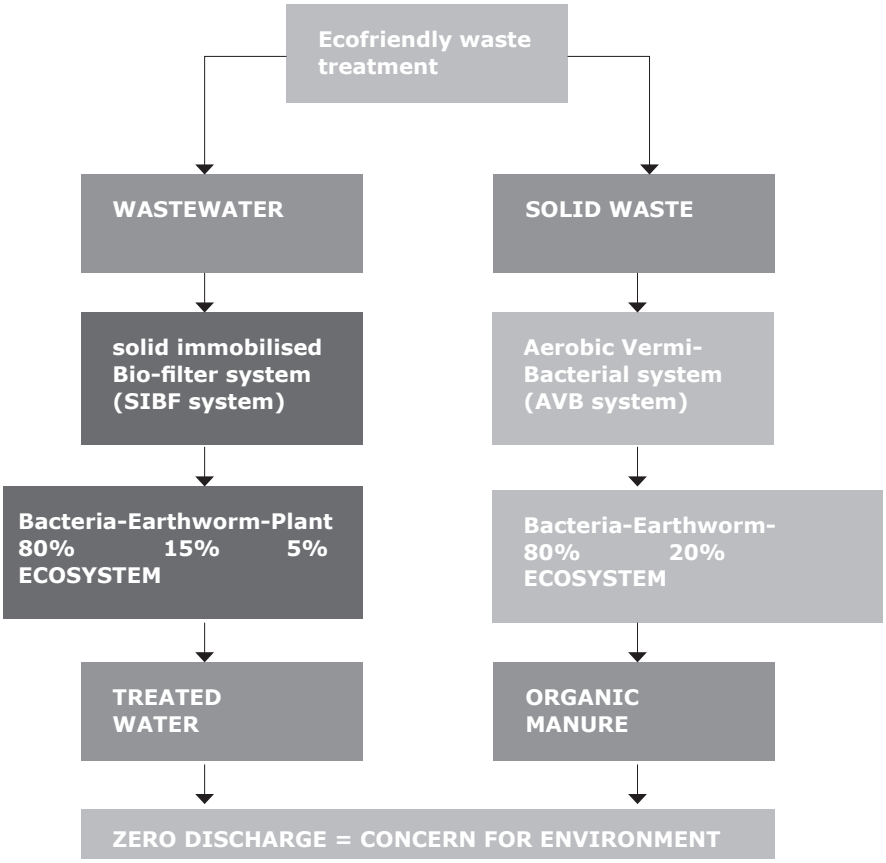


WASTE WATER TREATMENT

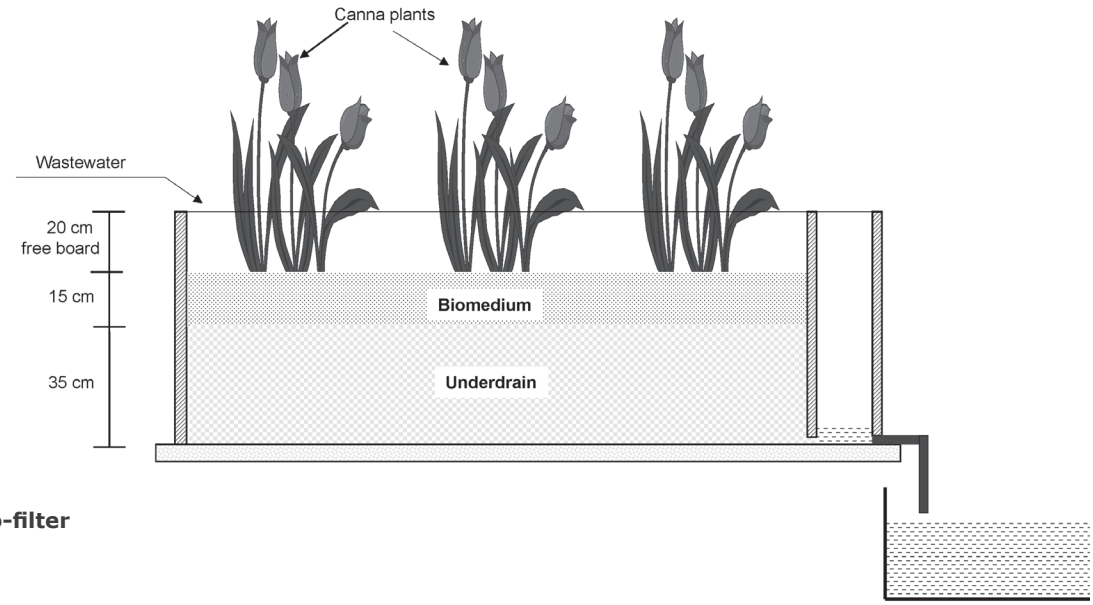
SIBF system is a natural method of wastewater treatment based on ecoloqical engineering. The treatment is achieved with the ecosystem of aerobic bacteria, earthworms, plants, This system has many advantages over the conventional treatment systems like the activated sludge process.

Benefits of SIBF system

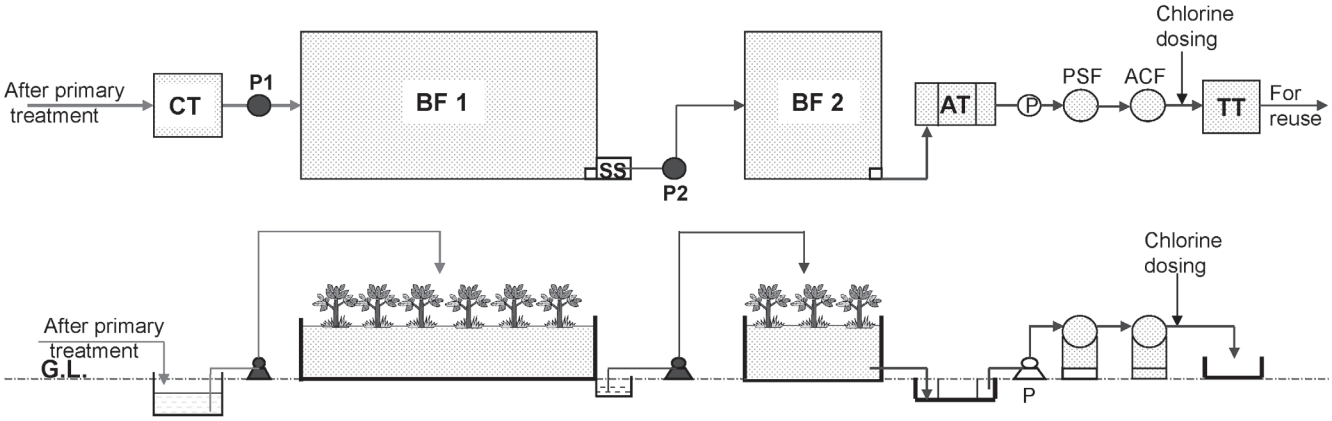
- Saves 90% on electricity
- Only gardener level operator required
- Hence - saves 90% on O & M cost
- No problem of flow fluctuations in holidays / vacations
- No secondary sludge
- A beautiful garden!



WASTE WATER TREATMENT

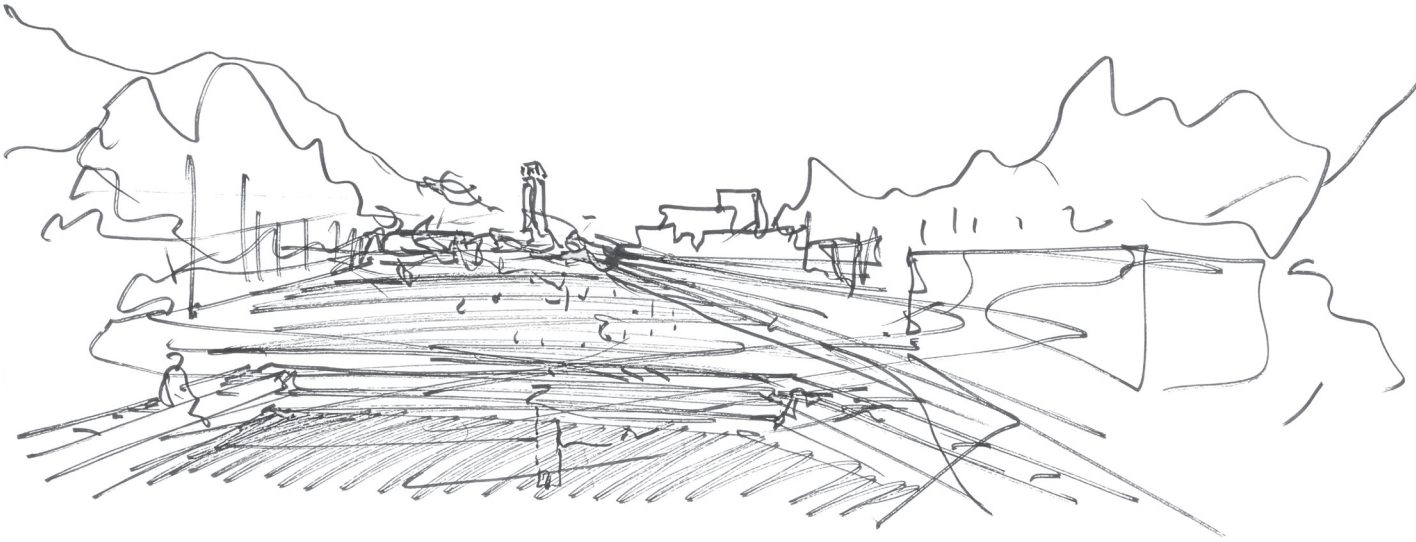


Cross section of Bio-filter



Typical hydraulic flow diagram for SIBF system

CT	Collection tank
BF1	Biofilter 1
SS	Side sump
BF2	Biofilter 2
AT	Alum tank
PSF	Pressure sand filter
ACF	Activated carbon filter
TT	Treated water tank
P	Non clog, self priming pumps with automation
	Canna plants (flowering plants)



FOR MAIN STREET

	Botanical Name	Local Name	Description	Typology of usage
1	**Albizia lebbeck**	SIRISH	A large tree planted as an avenue tree. Flowering season- March-JuneFruiting season- October-June	Grown for its beautiful crown and sweet scented flowers
2	**Mimusops elengi**	BAKUL	An evergreen tree with white fragrant Flowers. Flowering season- December-April	Grown for its shade
3	**Madhuca latifolia**	MAHUA	A large tree with flowers cream coloured in dense fascicles at the end of branches. Flowering season- January-April Fruiting season- April-July	Can be used as avenue tree
4	**Garuga pinnata**	KAKAD	A large tree with dark stem. Flowering season- November-April Fruiting season- April-June	
5	**Terminalia bellirica**	BAHEDO	A large tree. Flowering season- February-May Fruiting season- Cold season	Along roads as avenue tree
6	**Terminalia chebula**	HARDI	A large tree. Flowering season- March-May Fruiting season- Cold season	Along roads as avenue tree
7	**Tamarindus indica**	IMLI	A large tree. Flowering season- May-July Fruiting season- February-April	
8	**Schleichera oleasa**	KUSUM	A large tree, beautiful in May when in new pink or bright red leaves. Flowering season- February-May	
9	**Terminalia arjuna**	ARJUNA	A large deciduous tree, ht- 15-20mt, end of winter-leafless, new leaves: Mar-April, flowering: April-May, highly fragrant flowers	Along roads as avenue tree
10	**Terminalia crenulata**	SADADO	A large tree with dark brown cracked bark. Flowering season- April-August Fruiting season- December-April	Along roads as avenue tree

FOR INNER STREETS

	Botanical Name	Local Name	Description	Typology of usage
1	**Anogeissus latifolia**	DHAMODO	Erect trees with smooth whitish bark having grey patches. Flowering season- May-October Fruiting season- Cold season	
2	**Mitragyna parvifolia**	CHOTA KADAMB	A large tree with light green bark with shallow depressions of exfoliate scales, flowers yellow and fragrant.	Highly fragrant flowers
3	**Putanjiva roxburghii**		Mid-sized evergreen tree. Long, drooping branchlets. Flowers in early April.	Can be used as avenue tree
4	**Aegle marmelos**	BEL/BILI PATRA	A thorny tree with white flowers and woody fruit Flowering season- February-April Fruiting season- April-June	
5	**Pongamia pinnata**	KARANJ	A moderate sized tree with pinkish white flower. Flowering season- February-July Fruiting season- June-October	Along roads as avenue tree
6	**Erythrina variegata**	PANGARA	A tall tree with dazzling scarlet flowers. Flowering season- February-April Fruiting season- June-July	Attracts birds, Showy tree
7	**Symplocos racemosa**		Medium-sized trees with grey, thick, slightly rough bark, exfoliating in woody seal Leaves imparipinnate; leaflets ovate- lanceolate. Flowers yellowish-brown, fragrant, Leaves imparipinnate; leaflets ovate- lanceolate. Flowers dichotomous cymes. Capsule woody, pear shaped, pendulous	
8	**Schrebra switenoides**			
9	**Barleria prionitis**		Barleria is an erect, prickly shrub, usually Single-stemmed, growing to about 1.5 m tall.	Along roads as avenue tree
10	**Alstonia scholaris**	SAPTPARNI	A tall evergreen tree, ht: 15-20mt, flower: Aug-Oct. scented flowers: Dec-Feb.	Grown as ornamental tree. Also as avenue tree or as specimen inside lawns
11	**Millingtonia hortensis**	AKASH NIM	A tall tree with corky bark, dark green leaves and white flowers. Cultivated in gardens and along roads. Flowering season- Cold season	Avenue tree, also planted in gardens for its beautiful and fragrant flowers
12	**Gmelina arborea**	SEVAN	A deciduous tree with grey bark exfoliating in flakes and yellow flowers. Flowering season- March-May Fruiting season- May-June	

FOR COURTYARDS

	Botanical Name	Local Name	Description	Typology of usage
1	**Azadirachta indica**	NEEM	A large evergreen tree. Cultivated along the roads and in compounds for its shade. Flowering season- February-April Fruiting season- May-June	Sweet scent of flowers, ripe fruits is liked by birds. Can be used as avenue tree because of big shade giving foliage
2	**Ficus religiosa**	PIPAL	An evergreen tree with white fragrant Flowers. Flowering season- December-April	Grown for its shade
3	**Ficus benghalensis**	BARGAD	A very large evergreen tree with aerial roots from branches which become trunks in due course. Planted along roads and near villages. Flowering season- January-June	Can be used as avenue tree
4	**Anthocephalus kadamba**	KADAMB	A large tree.	Grownbecause of big shade giving foliage and straight trunk
5	**Mangifera indica**	AAM	A large evergreen tree. Flowering season- January-April Fruiting season- April-July	Along roads as avenue tree
6	**Ficus infectoria**	PEPAR	A quick growing large tree	Along roads as avenue tree
7	**Bombax malabaricum**	SEMAL	A large deciduous tree, ht: 25-30mt, large flowers varying from yellow to red, rarely off white at the end of the branch, flowering season: Feb, Fruits: May-June	Can be planted as an avenue tree or specimen tree
8	**Bombax malabaricum**	SEMAL	A large deciduous tree, ht: 25-30mt, large flowers varying from yellow to red, rarely off white at the end of the branch, flowering season: Feb, Fruits: May-June	Can be planted as an avenue tree or specimen tree
9	**Cassia fistula**	AMALTAS	Mid-sized, deciduous tree, Flowers are bright yellow and occur in long, drooping clusters; flowering: late April to mid-May. Fruiting: April – May. Can withstand poor, shallow, rocky soil and drought	Planted for its showy flower
10	**Tabernaemontana coronaria 'flore pleno'**	CHANDANI	A large bushy shrub with double white flowers. Flowering season- The whole year	Along roads as avenue tree
11	**Jasminum sambac**		Compact, bushy shrub. Ht: up to 1m. Fragrant flowers. Flowering: summer and rainy season.	
12	**Adhatoda vasica**	ARDUSI	An evergreen large leafy shrub, flower: Aug- Jan	Fragrant flowers
13	**Mallotus philippensis**	KAMILO	A small tree. Flowering season- September-January Fruiting season- Hot season	Can be used as avenue tree
14	**Grewia tiliaefolia**	DHAMAN	An erect tree with straight branches. Flowering season- March-June Fruiting season- August-October	Ripe fruits are eaten
15	**Jatropha gossypifolia**	LAL ERANDI	The upper parts of the plants purplish in colour. Flowering season- The whole year	Along roads as avenue tree

AGRICULTURAL FIELDS

	Botanical Name	Local Name	Description	Typology of usage
1	**Oryza saliva**			
2	**Phaseolus aureus**	GREEN GRAM		
3	**Jasminum sambac**	MOGRA		
4	**Zingiber officinale**	ADRAK		
5	**Ferula asafoetida**	HING		
6	**Potato**		They are are herbaceous perennials that grow about 60 cm. They bear white, pink, red, blue, or purple flowers with yellow stamens	
7	**Onion**	INDRA-JAV	A shrub or small tree with white scented flowers. Flowering season- February-August Fruiting season- June-January	
8	**Cauliflower**	GATHBOR	A large shrub or small tree with young parts pubescent. Flowering season- May-July Fruiting season- August-October	
9	**Crotalana juncea**		Crotalaria juncea, known as sunn or sunn hemp, is a tropical Asian plant of the legume family.	
10	**Moong**			
11	**Paddy**			
12	**Maize**			
13	**Eleusine coracana**	RAGI	Annual grass; culms erect, laterally flattened, 60-120 cm tall or long, profusely tillering, in addition to branches sent out at the rounded nodes in succession, plants often lodged or prostrate	
14	**Ricinus communis**	Castor- oil plant		

FOR ORCHARD

	Botanical Name	Local Name	Description	Typology of usage
1	**Syzygium cumini**	JAMUN	A large tree. Common, especially in moist localities. The fruit is eaten. Flowering season- April-June Fruiting season- June-July	
2	**Mangifera indica**	AAM	A large evergreen tree. Flowering season- January-April Fruiting season- April-July	Grown for its shade
3	**Phyllanthus emblica**	AMLA/AAVLA	A tree with crooked bole and greenish-grey bark. The fruit is eaten. Flowering season- March-may Fruiting season- October-February	Fruits are eaten
4	**Moringa oleifera**	SARAGVA	A tree with corky bark, white scented flowers, ribbed pods and winged seeds. The flowers and fruits are eaten as a vegetable. Flowering season- November-April Fruiting season- December-May	The flowers and fruits are eaten as a vegetable
5	**Punica granatum**	ANAR	A shrub or small tree with bright red flowers and globose fruit, flowering season: Oct-Dec, Fruiting season- March-May	Attracts birds
6	**Psidium guajava**	GUAVA / AMRUT	A small tree flowers: March- May, cultivated for fruits: throughout the year	Attracts birds
7	**Zizyphus Jujuba**	BER	A large spiny shrub or small trees, Common in waste lands and open forest, fruits-in winter, are eaten	Can be planted as an avenue tree or specimen tree
8	**Carissa carandas**	KARWANDA	A large evergreen spiny shrub, white fragrant flowers: Jan-March, Fruit: April-May	Attracts birds
9	**Citrus lemon**		Mid-sized, deciduous tree, Flowers are bright yellow and occur in long, drooping clusters; flowering: late April to mid-May. Fruiting: April – May. Can withstand poor, shallow, rocky soil and drought	Planted for its showy flower
10	**Tabernaemontana coronaria 'flore pleno'**	NIMBU	Cultivated for fruits	Along roads as avenue tree
11	**Cajanus indicus**			
12	**Artocarpus heterophyllus**	JACK FRUIT	Trees typically reach a height of 8–25 m and a canopy diameter of 3.5–6.7 m at 5 years of age.	
14	**Litchi chinensis**	LITCHI	An evergreen tree reaching 10–28 metres tall, the lychee bears fleshy fruits that are up to 5 cm long and 4 cm wide. The outside of the fruit is covered by a pink-red, roughly textured rind that is inedible but easily removed to expose a layer of sweet, translucent white flesh. Flowers grow on a terminal inflorescence with many panicles on the current season's growth	
15	**Grewia asiatica**	PHALSA	Small, bushy tree. Fruits ripen in summer	
16	**Jatropha gossypifolia**	LAL ERANDI	The upper parts of the plants purplish in colour. Flowering season- The whole year	Along roads as avenue tree

FOREST TREES

	Botanical Name	Local Name	Description	Typology of usage
1	**Butea monosperma**	PALAASH	A tree with beautiful bright orange red flowers. Flowering season- December-March Fruiting season- February-April	Planted in gardens in groups, flowering tree
2	**Acacia ferruginea**	KANTI	A tree with rusty brown bark. Flowering season- January-April Fruiting season- Cold season	
3	**Acacia catechu**	KHERIYO BAVAL	A tree with young shoots brown or purple. Flowering season- August-October Fruiting season- Cold season	
4	**Strychnos potatorum**	KANTAS	A tree with black cracked bark. Flowering season- March-may Fruiting season- May-June	
5	**Diospyros melanoxylon**	TIMRU	A tree with dark grey or black exfoliates in rectangular scales. Flowering season- February –April Fruiting season- April-June	
6	**Prosopis cineraria**	KHEJRI	A tree common in hedges, waste lands and fields, especially in black cotton soil. Flowering season- October-March Fruiting season- March-August	Extremely adaptable. Can tolerate extremely alkaline soil and salt concentration. Enormous taproot that can penetrate up to 30 mts
7	**Holarrhena antidysenterica**	INDRA-JAV	A shrub or small tree with white scented flowers. Flowering season- February-August Fruiting season- June-January	
8	**Zizyphus xylopurus**	GATHBOR	A large shrub or small tree with young parts pubescent. Flowering season- May-July Fruiting season- August-October	
9	**Salvadora persica**	PILU	A much branched evergreen shrub or small tree. Often gregarious in saline localities. Flowering season- October-February Fruiting season- January-May	Gives feeling of forest
10	**Tabernaemontana coronaria 'flore pleno'**	CHANDANI	A large bushy shrub with double white flowers. Flowering season- The whole year	Along roads as avenue tree
11	**Calotropis gigantean**	MOTA AKDA	A shrub. Flowering season- The whole year	
12	**Datura metel**	DHANTURA	An undershrub; flowers purple outside, fruit a prickly capsule. Flowering season- September-February Fruiting season- December-March	
14	**Dalbergia sisso**	SHISHAM	A large deciduous tree with young leaves appear in Feb, ht-20mt. flowering season- March, fruiting season- Winter	
15	**Vitex nigundo**	NAGOD	A large shrub with bluish or pulpish-white flowers. Flowering season- Throughout the year Fruiting season- Throughout the year	
16	**Melia azadirach**	AKASH NIM	A tree with dark grey bark cultivated in compounds and along roads. A tree with dark grey bark cultivated in compounds and along roads. Flowering season- March-May Fruiting season- April-June	
17	**Baliospermum montanum**		Baliospermum montanum is a stout under-shrub 0.9-1.8m in height with herbaceous branches from the roots. Leaves are simple, sinuate-toothed, upper ones small, lower ones large and sometimes palmately 3-5 lobed. Flowers are numerous, arranged in axillary racemes with male flowers above and a few females below.	
18	**Kydia calycina**		Kydia is a tree, growing up to 20 m tall. Leaf stalk 2-7.5 cm long. Flowers occur in panicles; pedicel 4-8 mm long, in fruit up to 1.5 cm long. in fruit up to 12 mm long, 6 mm broad, obovate or spathulate, prominently nerved, brown	
19	**Coix lachrymal-jobi**	KANSAR	A tall stout gregarious grass. Common in standing water and along banks of perennial nalas	

EARTHQUAKE RESISTANT CONSTRUCTION

REGIONAL CONTEXT

Our site for the Nalanda University lies in the Seismic Zones III and IV, where the Damage Risk factor due to earthquakes ranges from moderate to high. The design proposed by us responds to these conditions.

Our buildings are designed to resist horizontal loads from any direction. Our buildings will be constructed in framed masonry, which help transfer all horizontal forces produced within the building to the ground. Building elements are reinforced and tied together to reduce weakness in the structure caused by bricks, which are generally brittle in nature.

Certain design aspects were kept in mind during the designing process to ensure earthquake resistance:

1 **Symmetry**: The buildings are symmetrical about both the axes. This ensures reduction in torsion created in the building during an earthquake.

2 **Regularity**: Simple rectangular shapes behave better in an earthquake. Torsional effects of ground motion are pronounced in long narrow rectangular blocks. Therefore our buildings are always rectangular and no more that three times their width.

3 **Simplicity**: Our buildings are simply detailed keeping large cornices, vertical or horizontal cantilever projections; facia stones and the like to a minimum.

4 **Enclosed Areas**: the building typologies are such that cloisters of rooms are formed around courtyards. These act like rigid boxes since the earthquake strength which long walls derive from transverse walls increases as their length decreases.

Since most of our buildings are to be in exposed brick masonry (a brittle material) they are formed with RCC beams, columns and lintels, which increase the ductility of the material. Doing so ensures that the structure is well tied together as well as allows for sufficient amount of deformation within the structure. This ensures that the forces are transmitted from one component to another and excessive stress concentrations within joints are avoided.

It is proposed to isolate the structure from the ground motion to reduce the impact of the forces on the structure. This is to be done by **base-isolation**, where the structure and the foundation are to be separated by two layers of good quality plastic so that the plastic layers may slide over one another. This reduces the coefficient of friction between the structure and the foundation by placing a flexible connection between the two.

We have considered framed construction, consisting of rigid jointed beams and columns, which are capable of resisting lateral loads by itself. Framed constructions can be used for a greater number of stories compared to bearing wall construction. The strength of the framed construction is not affected by the size and number of openings.

The soil at our site is mainly soft, which has an allowable bearing capacity of 10 t/m2. Pile foundations have been chosen as the appropriate type of foundations for this site.

In accordance with the value of the design seismic coefficient, the building category has been taken as follows for selecting earthquake resistant features:

Building	Zone IV
Housing	D
Community buildings (schools, hospitals, congregation halls etc.)	E

To achieve Seismic safety, the following have been determined in accordance with **IS-4326** [*Indian Standard Code of Practice for Earthquake Resistant Design and Construction of Buildings* (2nd Revision)].

1 Length, height and thickness of walls

2 Size and location of openings

3 Material strength and quality of construction

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Seismic bands consisting of reinforced concrete flat runners are to run through **all external and internal masonry walls** at the following levels in the building.

1 At the plinth level of the building

2 At the levels of lintels of doors and windows.

Where flat roofs are adopted:

1 Seismic band at ceiling level of floors or roofs.

2 Stiffening of prefab elements in roofs/floor where used (using peripheral seismic band and RC screed integrated together).

Where sloping/pitched roof is used:

1 Seismic band at eave level of sloping roofs.

2 Seismic band at top of gable wall and ridge wall top (where such walls used).

3 Bracing in roof structure of trussed as well as raftered roofs.

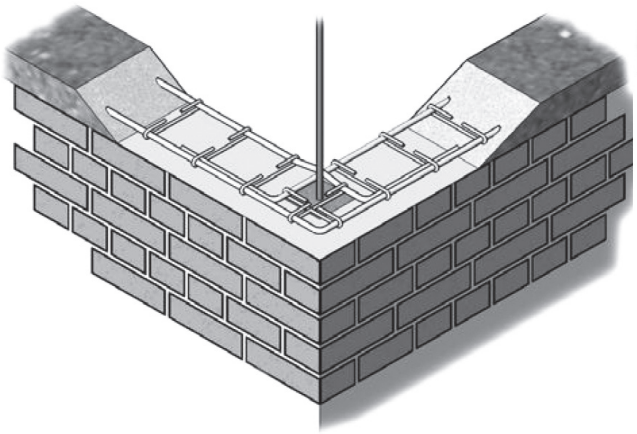
4 Vertical Steel bar at each corner and T junction of walls.

Additional measures for all buildings of Category E:

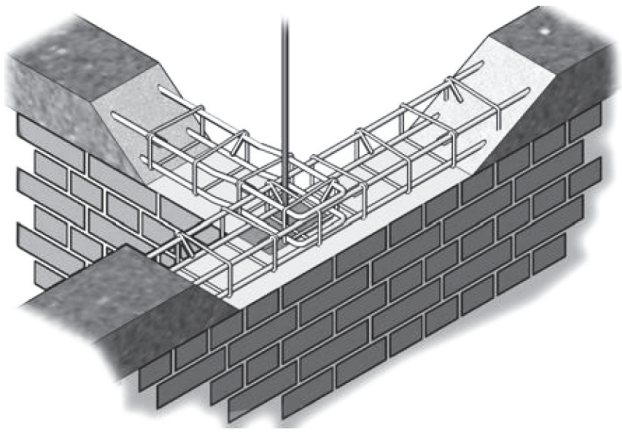
1 Seismic band or dowels have been integrated at corners and T-junctions at window sill level.

To ensure good seismic performance of our buildings, all walls are joined to their adjacent walls. By doing this, walls loaded in their weak direction can take advantage of the good lateral resistance offered by walls loaded in their strong direction. Furthermore walls are also tied to the roof and foundations.

1 Longitudinal reinforcements
2 Lateral ties
3 Vertical reinforcement at corners
b, b1, b2 wall thickness



View of L-type wall junction



View of T-type wall junction

The cement ratio required for this particular zone is 1:6 (i.e. 1 part cement with 6 parts sand)

For earthquake safety of category E buildings

- Reinforcing bars are to be embedded in brick masonry at the corners of all the rooms and the side of the door openings.
- Window openings larger than 60 cm in width will also need such reinforcing bars. (The diameter of the bar depends upon the number of stories in the building.)

No. of storeys	Storeys	Diameter of single HSD (TOR) bar at corners of room	
		Cat. D	Cat. E
One	–	10	12
Two	Top	10	12
	Bottom	12	16

Vertical Bars at Corners of Room

- These vertical bars are to be started from the foundation concrete, will pass through all seismic bands where they will be tied to the band reinforcements using binding wire and embedded to the ceiling band/roof slab as the case may be using a 300 mm 90° bend.

Image source: Guide Lines for **Earthquake Resistant Construction and New Construction of Masonry Buildings in Jammu and Kashmir**. Prof Anand S Arya, GoI_ UNDP DRM Program. October 2005.

COST AND AREAS

HUNDREDHANDS

9/2, MADRAS BANK ROAD, BANGALORE-01

Preliminary estimate of Proposed University Building for Nalanda Univeristy at Bihar.

SL NO	DESCRIPTION	UNIT	AREA	Rate	for Addtnal Ht	for addtnl Tot RATE	AMOUNT
B	**Student Residence**						
	Civil Works						
	Type A	SQM	11336	₹ 16,500.00	270	₹ 16,770.00	₹ 190,104,720.00
	Type B	SQM	5668	₹ 16,500.00	270	₹ 16,770.00	₹ 95,052,360.00
	Additional cost for Earthquake resistance	SQM	17004			₹ 1,140.00	₹ 19,384,560.00
	Additional cost for Pile Foundation	SQM	5668			₹ 11,750.00	₹ 66,599,000.00
	Cost of Civil Works						₹ 371,140,640.00
	Services						
	Water supply&Sanitary works at 15% of Civil Works						₹ 55,671,096.00
	Int Electrical Services at 12.5% of Civil Works						₹ 46,392,580.00
	External Service Connetions 5% of Civil Works						₹ 18,557,032.00
	Cost of Services						**₹ 120,620,708.00**
	Total Cost						**₹ 491,761,348.00**
C,D	**Teaching/Non Teaching Staff Residence_Apartments**						
	Civil Works	SQM	6818	₹ 16,000.00	675	₹ 16,675.00	₹ 113,690,150.00
	Additional cost for Earthquake resistance	SQM	6818			₹ 1,140.00	₹ 7,772,520.00
	Additional cost for Pile Foundation	SQM	2272.67			₹ 11,750.00	₹ 26,703,833.33
	Cost of Civil Works						**₹ 148,166,503.33**
	Services						
	Water supply&Sanitary works at 4% of Civil Works						₹ 5,926,660.13
	Int Electrical Services at 12.5% of Civil Works						₹ 18,520,812.92
	External Service Connetions 5% of Civil Works						₹ 7,408,325.17
	Cost of Services						**₹ 31,855,798.22**
	Total Cost						**₹ 180,022,301.55**
C,D	**Teaching/Non Teaching Staff Residence_Villas**						
	Civil Works	SQM	7898	₹ 16,000.00	405	₹ 16,405.00	₹ 129,566,690.00
	Additional cost for Earthquake resistance	SQM	7898			₹ 1,140.00	₹ 9,003,720.00
	Additional cost for Pile Foundation	SQM	3949			₹ 11,750.00	₹ 46,400,750.00
	Cost of Civil Works						**₹ 184,971,160.00**
	Services						
	Water supply&Sanitary works at 4% of Civil Works						₹ 7,398,846.40
	Int Electrical Services at 12.5% of Civil Works						₹ 23,121,395.00
	External Service Connetions 5% of Civil Works						₹ 9,248,558.00
	Cost of Services						**₹ 39,768,799.40**
	Total Cost						**₹ 224,739,959.40**
A4,A5	**Faculty Building and Part of A11-20**						
	Civil Works	SQM	9500	₹ 23,500.00	1350	500 ₹ 25,350.00	₹ 240,825,000.00
	Additional cost for Earthquake resistance	SQM	9500			₹ 1,140.00	₹ 10,830,000.00
	Additional cost for Pile Foundation	SQM	3166.67			₹ 11,750.00	₹ 37,208,333.33
	Cost of Civil Works						**₹ 288,863,333.33**
	Services						
	Water supply&Sanitary works at 4% of Civil Works						₹ 11,554,533.33
	Int Electrical Services at 12.5% of Civil Works						₹ 36,107,916.67
	External Service Connetions 5% of Civil Works						₹ 14,443,166.67
	Elevators	NOS	2			₹ 2,800,000.00	₹ 5,600,000.00
	Cost of Services						**₹ 67,705,616.67**
	Total Cost						**₹ 356,568,950.00**
E 11	**Bank**						
	Civil Works	SQM	690	₹ 23,500.00	405	₹ 23,905.00	₹ 16,494,450.00
	Additional cost for Earthquake resistance	SQM	690			₹ 1,140.00	₹ 786,600.00

	Additional cost for Pile Foundation	SQM	390				₹ 11,750.00	₹ 4,582,500.00
	Cost of Civil Works							**₹ 21,863,550.00**
	Services							
	Water supply&Sanitary works at 4% of Civil Works							₹ 874,542.00
	Int Electrical Services at 12.5% of Civil Works							₹ 2,732,943.75
	External Service Connetions 5% of Civil Works							₹ 1,093,177.50
	Elevators	NOS	1				₹ 2,800,000.00	₹ 2,800,000.00
	Cost of Services							**₹ 7,500,663.25**
	Total Cost							**₹ 29,364,213.25**
E9	**Medical Center**							
	Civil Works	SQM	3000	₹ 23,500.00	718.2		₹ 24,218.20	₹ 72,654,600.00
	Additional cost for Earthquake resistance	SQM	3000				₹ 1,140.00	₹ 3,420,000.00
	Additional cost for Pile Foundation	SQM	2100				₹ 11,750.00	₹ 24,675,000.00
	Cost of Civil Works							**₹ 100,749,600.00**
	Services							
	Water supply&Sanitary works at 10% of Civil Works							₹ 10,074,960.00
	Int Electrical Services at 12.5% of Civil Works							₹ 12,593,700.00
	External Service Connetions 5% of Civil Works							₹ 5,037,480.00
	Elevators	NOS	2				₹ 2,800,000.00	₹ 5,600,000.00
	Cost of Services							**₹ 33,306,140.00**
	Total Cost							**₹ 134,055,740.00**
E11	**Fire Station**							
	Civil Works	SQM	798	₹ 23,500.00	1080	1000	₹ 25,580.00	₹ 20,412,840.00
	Additional cost for Earthquake resistance	SQM	798				₹ 1,140.00	₹ 909,720.00
	Additional cost for Pile Foundation	SQM	798				₹ 11,750.00	₹ 9,376,500.00
	Cost of Civil Works							**₹ 30,699,060.00**
	Services							
	Water supply&Sanitary works at 4% of Civil Works							₹ 1,227,962.40
	Int Electrical Services at 12.5% of Civil Works							₹ 3,837,382.50
	External Service Connetions 5% of Civil Works							₹ 1,534,953.00
	Cost of Services							**₹ 6,600,297.90**
	Total Cost							**₹ 37,299,357.90**
E 13	**Post Office**							
	Civil Works	SQM	150	₹ 23,500.00			₹ 23,500.00	₹ 3,525,000.00
	Additional cost for Earthquake resistance	SQM	150				₹ 1,140.00	₹ 171,000.00
	Additional cost for Pile Foundation	SQM	150				₹ 11,750.00	₹ 1,762,500.00
	Cost of Civil Works							**₹ 5,458,500.00**
	Services							
	Water supply&Sanitary works at 4% of Civil Works							₹ 218,340.00
	Int Electrical Services at 12.5% of Civil Works							₹ 682,312.50
	External Service Connetions 5% of Civil Works							₹ 272,925.00
	Cost of Services							**₹ 1,173,577.50**
	Total Cost							**₹ 6,632,077.50**
E2	**Campus Inn**							
	Civil Works	SQM	4200	₹ 23,500.00	629.1		₹ 24,129.10	₹ 101,342,220.00
	Additional cost for Earthquake resistance	SQM	4200				₹ 1,140.00	₹ 4,788,000.00
	Additional cost for Pile Foundation	SQM	1775				₹ 11,750.00	₹ 20,856,250.00
	Cost of Civil Works							**₹ 126,986,470.00**
	Services							
	Water supply&Sanitary works at 4% of Civil Works							₹ 5,079,458.80
	Int Electrical Services at 12.5% of Civil Works							₹ 15,873,308.75
	External Service Connetions 5% of Civil Works							₹ 6,349,323.50

	Elevators	NOS	3				₹ 2,800,000.00	₹ 8,400,000.00
	Cost of Services							**₹ 35,702,091.05**
	Total Cost							**₹ 162,688,561.05**
E3	**International Centre**							
	Civil Works	SQM	4000	₹ 23,500.00	629.1		₹ 24,129.10	₹ 96,516,400.00
	Additional cost for Earthquake resistance	SQM	4000				₹ 1,140.00	₹ 4,560,000.00
	Additional cost for Pile Foundation	SQM	1609				₹ 11,750.00	₹ 18,905,750.00
	Cost of Civil Works							**₹ 119,982,150.00**
	Services							
	Water supply&Sanitary works at 4% of Civil Works							₹ 4,799,286.00
	Int Electrical Services at 12.5% of Civil Works							₹ 14,997,768.75
	External Service Connetions 5% of Civil Works							₹ 5,999,107.50
	Elevators	NOS	3				₹ 2,800,000.00	₹ 8,400,000.00
	Cost of Services							**₹ 34,196,162.25**
	Total Cost							**₹ 154,178,312.25**
E1	**Faculty Club**							
	Civil Works	SQM	3200	₹ 23,500.00	810		₹ 24,310.00	₹ 77,792,000.00
	Additional cost for Earthquake resistance	SQM	3200				₹ 1,140.00	₹ 3,648,000.00
	Additional cost for Pile Foundation	SQM	3200				₹ 11,750.00	₹ 37,600,000.00
	Cost of Civil Works							**₹ 119,040,000.00**
	Services							
	Water supply&Sanitary works at 4% of Civil Works							₹ 4,761,600.00
	Int Electrical Services at 12.5% of Civil Works							₹ 14,880,000.00
	External Service Connetions 5% of Civil Works							₹ 5,952,000.00
	Cost of Services							**₹ 25,593,600.00**
	Total Cost							**₹ 144,633,600.00**
E10	**Dining Hall**							
	Civil Works	SQM	5400	₹ 23,500.00	3739.5	1500	₹ 28,739.50	₹ 155,193,300.00
	Additional cost for Earthquake resistance	SQM	5400				₹ 1,140.00	₹ 6,156,000.00
	Additional cost for Pile Foundation	SQM	4233				₹ 11,750.00	₹ 49,737,750.00
	Cost of Civil Works							**₹ 211,087,050.00**
	Services							
	Water supply&Sanitary works at 15% of Civil Works							₹ 31,663,057.50
	Int Electrical Services at 12.5% of Civil Works							₹ 26,385,881.25
	External Service Connetions 5% of Civil Works							₹ 10,554,352.50
	Fire alaram	SQM	5400				₹ 500.00	₹ 2,700,000.00
	Sprinkler system	SQM	5400				₹ 1,500.00	₹ 8,100,000.00
	Elevators	NOS	1				₹ 2,800,000.00	₹ 2,800,000.00
	Cost of Services							**₹ 82,203,291.25**
	Total Cost							**₹ 293,290,341.25**
A21	**Library**							
	Civil Works	SQM	8438	₹ 23,500.00	1485	1500	₹ 26,485.00	₹ 223,480,430.00
	Additional cost for Earthquake resistance	SQM	8438				₹ 1,140.00	₹ 9,619,320.00
	Additional cost for Pile Foundation	SQM	2481				₹ 11,750.00	₹ 29,151,750.00
	Cost of Civil Works							**₹ 262,251,500.00**
	Services							
	Water supply&Sanitary works at 4% of Civil Works							₹ 10,490,060.00
	Int Electrical Services at 12.5% of Civil Works							₹ 32,781,437.50
	External Service Connetions 5% of Civil Works							₹ 13,112,575.00
	Fire alaram	SQM	8438				₹ 500.00	₹ 4,219,000.00
	Sprinkler system	SQM	8438				₹ 1,500.00	₹ 12,657,000.00
	Elevators	NOS	3				₹ 2,800,000.00	₹ 8,400,000.00
	Cost of Services							**₹ 81,660,072.50**
	Total Cost							**₹ 343,911,572.50**

A1-A3,E4	**Admin Block**							
	Civil Works	SQM	2000	₹ 23,500.00	1350	750	₹ 25,600.00	₹ 51,200,000.00
	Additional cost for Earthquake resistance	SQM	2000				₹ 1,140.00	₹ 2,280,000.00
	Additional cost for Pile Foundation	SQM	1056.69				₹ 11,750.00	₹ 12,416,107.50
	Cost of Civil Works							**₹ 65,896,107.50**
	Services							
	Water supply&Sanitary works at 4% of Civil Works							₹ 2,635,844.30
	Int Electrical Services at 12.5% of Civil Works							₹ 8,237,013.44
	External Service Connetions 5% of Civil Works							₹ 3,294,805.38
	Elevators	NOS	1				₹ 2,800,000.00	₹ 2,800,000.00
	Cost of Services							**₹ 16,967,663.11**
	Total Cost							**₹ 82,863,770.61**
A11-20	**Communication Centre**							
	Civil Works	SQM	2600	₹ 23,500.00	540	750	₹ 24,790.00	₹ 64,454,000.00
	Additional cost for Earthquake resistance	SQM	2600				₹ 1,140.00	₹ 2,964,000.00
	Additional cost for Pile Foundation	SQM	1399.2				₹ 11,750.00	₹ 16,440,600.00
	Cost of Civil Works							**₹ 83,858,600.00**
	Services							
	Water supply&Sanitary works at 4% of Civil Works							₹ 3,354,344.00
	Int Electrical Services at 12.5% of Civil Works							₹ 10,482,325.00
	External Service Connetions 5% of Civil Works							₹ 4,192,930.00
	Elevators	NOS	2				₹ 2,800,000.00	₹ 5,600,000.00
	Cost of Services							**₹ 23,629,599.00**
	Total Cost							**₹ 107,488,199.00**
E8	**Sports Centre**							
	Civil Works	SQM	1000	₹ 23,500.00	270	1500	₹ 25,270.00	₹ 25,270,000.00
	Additional cost for Earthquake resistance	SQM	1000				₹ 1,140.00	₹ 1,140,000.00
	Additional cost for Pile Foundation	SQM	1000				₹ 11,750.00	₹ 11,750,000.00
	Cost of Civil Works							**₹ 38,160,000.00**
	Services							
	Water supply&Sanitary works at 4% of Civil Works							₹ 1,526,400.00
	Int Electrical Services at 12.5% of Civil Works							₹ 4,770,000.00
	External Service Connetions 5% of Civil Works							₹ 1,908,000.00
	Elevators	NOS	1				₹ 2,800,000.00	₹ 2,800,000.00
	Cost of Services							**₹ 11,004,400.00**
	Total Cost							**₹ 49,164,400.00**
	Ext Development Works							
1	Levelling	SQM	63500				95	₹ 6,032,500.00
2	Roads	SQM	63500				145	₹ 9,207,500.00
3	Street Lighting	SQM	63500				95	₹ 6,032,500.00
4	Severline	SQM	63500				110	₹ 6,985,000.00
5	Storm Water Drain	SQM	63500				85	₹ 5,397,500.00
6	Water Supply	SQM	63500				80	₹ 5,080,000.00
7	OHT-20m high	LIT	1000000				25	₹ 25,000,000.00
8	Sump Tank	LIT	1500000				15	₹ 22,500,000.00
	Total for External Development Works							**₹ 86,235,000.00**

Summary of Cost

Student Block(Hostel)	₹ 491,761,348.00
Teaching/Non Teaching Staff Residence_Apartments	₹ 180,022,301.55
Teaching/Non Teaching Staff Residence_Villas	₹ 224,739,959.40
Faculty Building and Part of A11-20	₹ 356,568,950.00
Bank	₹ 29,364,213.25
Medical Center	₹ 134,055,740.00
Fire Station	₹ 37,299,357.90
Post Office	₹ 6,632,077.50
Campus Inn	₹ 162,688,561.05
International Centre	₹ 154,178,312.25
Faculty Club	₹ 144,633,600.00
Dining Hall	₹ 293,290,341.25
Library	₹ 343,911,572.50
Admin Block	₹ 82,863,770.61
Communication Centre	₹ 107,488,199.00
Sports Centre	₹ 49,164,400.00
Ext Development Works	₹ 86,235,000.00
TOTAL PRELIMINARY COST FOR PHASE 1	**₹ 2,884,897,704.26**