A House in the Tropics;
Konkan, India

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the Degree of Master of Architecture

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Dedicated to the memory of Late Shri. Ramesh Shankar Samant,
a true son of the soil whose love and affection has
kept me closer to my roots and native soil.

Outline

abstract

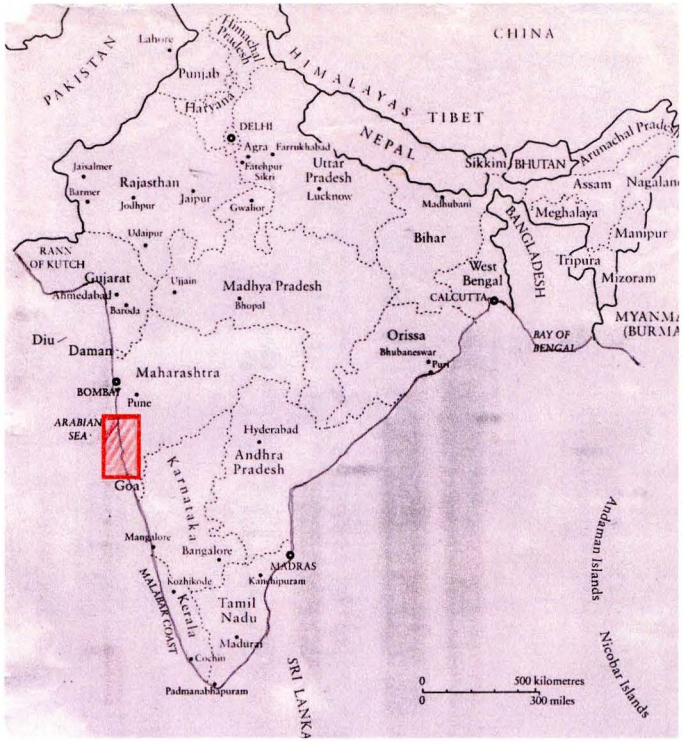
The proposed house is an extension to an existing 150-year-old house in a rural village in Coastal India.

The existing house is to be adapted to serve as a factory to produce local food products and store the farm products. Parts of the house need to undergo change and new materials need to be introduced to solve existing problems and adapt to the new program. A modest house, (about 1500 sq.ft.) is to be designed next to the existing house to suit the lifestyle of the users, creating a living and working environment.

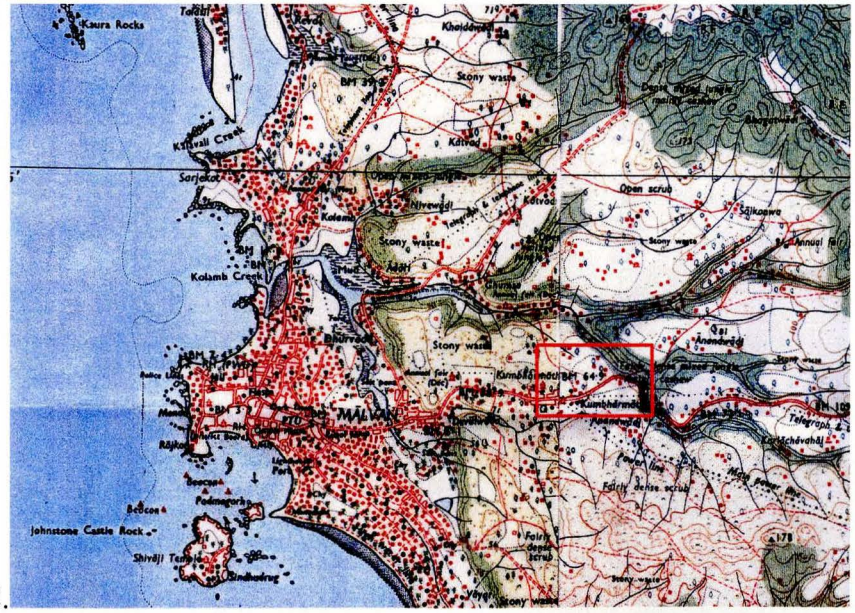
Materials and method of construction design should allow respect for the customs and traditions of the local land as well as respond to the changing lifestyle and requirements. Use of local materials and cost effective, available technology is important. The house needs to be well ventilated and comfortable without the use of HVAC system.

the location

The state of Maharashtra, in the western part of India, of which Mumbai is the capital city, is geographically divided into two major parts; the Deccan plateau spreading across most of Southern Indian peninsula and the Konkan area which is a narrow coastal strip running down the western side of the peninsula separated by the Sahyadri mountain range (the Western "Ghats").



A.

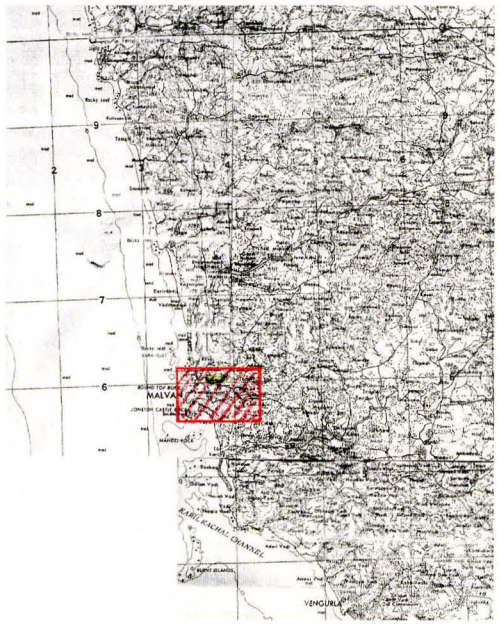


C.

A. Map of Indian Peninsula

B. Coastal Maharashtra (Konkan)

C. Malvan area

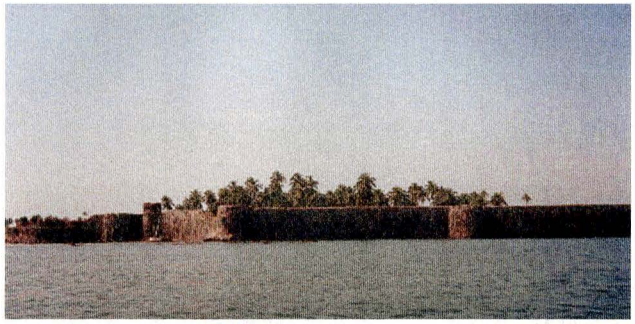


B.

konkan

The Konkan strip had been vastly neglected in the past with very little opportunities for prosperity. Most of the Konkani people ended up working in Mumbai City. The local people are known for being modest and docile with deep-rooted pride and respect for their land and traditions. As a result of their increasing political power gained by these expatriates in Mumbai and elsewhere, this region has started to open up and prosper in the recent past. The Konkan Railway, an ambitious project was recently completed setting a number of records in terms of speedy completion, highest viaducts, longest tunnels, etc. The Sagari Mahamarga, a highway connecting most of the coastal towns is also nearing completion, winding across numerous creeks and water inlets and hilly terrain.

The Konkan strip south of Mumbai is made up of three districts: Raigad, Ratnagiri and Sindhudurg. Sindhudurg district is the southern most district, which borders with the state of Goa.



Sindhudurg Fort

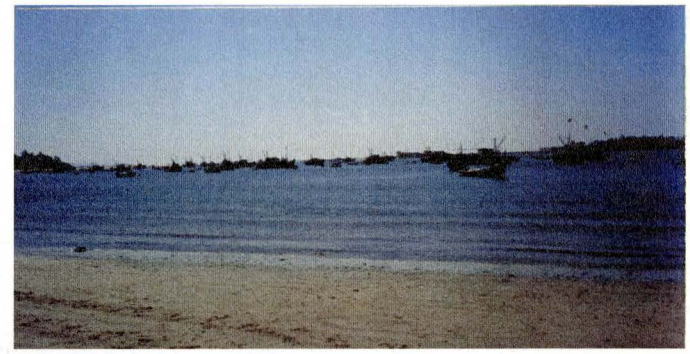
Ramparts of the Sindhudurg Fort

Famous for the picturesque beauty of its pristine beaches and blue waters, Malvan is an old town in Sindhudurga district. Just a mile off its coast is the famous 16th century island fort - Sindhudurga (sea fort) built by Chatrapati Shivaji, from which the district gets its name. The site of this fort was personally selected by Shivaji. It was built in 1667. Sprawled over an area of 48 acres, once seized by the British, and renamed Fort Augustus, the fort's strength was its inaccessibility. It is approachable only through a narrow navigable channel between the two smaller islands of Dhontara and Padmagarh.

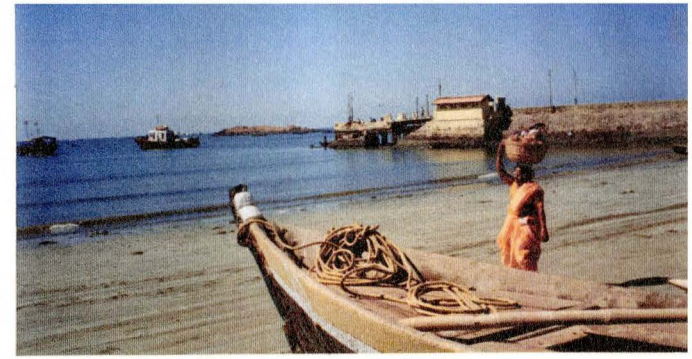
Malvan also has the only marine sanctuary in the region. The 29.22 sq. km. in Malvan Taluka was declared as marine sanctuary in 1987. This area is rich in coral and marine life.

The region receives about 330-360 cm. of rain every monsoon season which lasts from July-September.

Monday weekly bazaar (market) on the Malvan beach



Malvan beach with Sindhudurg fort in the background



Malvan harbor

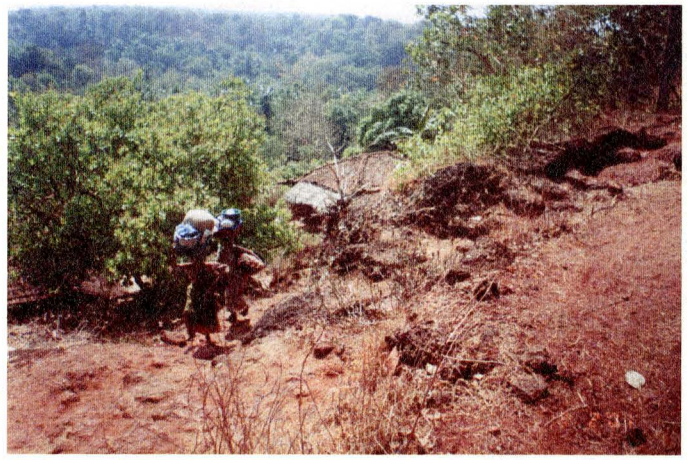
geology

The geology of the surrounding area is unique. It is made up of "Sada" - or laterite capped plateau with fertile valleys cutting through these ranges.

The Sada is hot, mostly barren, used mostly for cattle grazing and growing paddy during the rainy season. The latter is achieved by putting a thin layer of fertile soil (brought up from the valley below) on the flatter laterite strata.

The slopes descending into the valley are planted generally with mango and cashew trees. The lower slopes of the valley and flat terrain on either side of the "Vhal" – or stream are usually used for dwelling-clusters and thick groves of coconut and betel nut palms, pineapple and numerous other exotic fruits, flowers and spices. A "Ghati" , derived from Ghat is a descending stepped trail from the Sada to the valley and has been the shared means of movement for man and material before the advent of vehicular roads. The small river or seasonal stream flowing through the valley enriches the soil every year during the monsoon floods. The plantations on

Typical "Sada". Stony with golden grass.



Sales women climbing the "Ghati" with their goods.

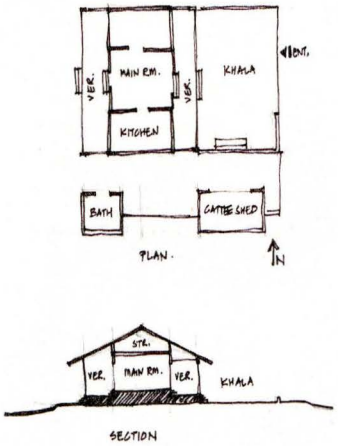
the slopes do not need constant irrigation after the first two years of planting. They can live off the rain that lasts for four monsoon months every year. The plantations on the floor of the valley are irrigated by an elaborate network of water channels.

The Sada, although barren, is dotted with small towns along the roads - with their small farms and orchards – subsisting on locally available water sources. These communities usually have road-side shops, cafes, marketing and storage spaces, small scale industries, schools, post offices, etc.; which act as centers for daily activities of the settlers from nearby valleys. The villages in the valleys are usually not accessible by vehicular roads. Residents use the "Ghatis" to descend into the valleys. The "Vhals" or streams usually have pedestrian bridges called "Sakavs", which reverberate with laughter and shouted messages across the stream and also serve as diving platforms for swimming children.

Road side housing area on the 'sada'
Old laterite quarry now collects trash. Could be put to better use.
Water supply to these houses from wells and bore-wells.

a typical house

A typical house plan in this region has a three layered transition of spaces from public to private consisting of a "Khala" or front yard, a verandah and the living area on the front and the rear of the house.



typical house plan and section

The Khala, leveled and plastered with cow dung is an important part of the house. It is a multipurpose space, for gathering during functions, recreation, making sun-dried products, etc. From the Khala one enters the verandah usually a couple of feet higher, which is also a public space, sometimes separated by a colonnade or a wooden screen.

Hence there is a transition from public to semi-public to private spaces. Guests are usually entertained in the verandah space unless they are invited over for dinner, in which case, they dine in the main central room. Passersby and neighbors use the khala as a place to greet and chat with each other without entering the house. Similarly the rear of the house also has a verandah, which is used as a workshop for farm products.

A typical house with sloping tiled roof, mud walls and khala in the front. Entrance from the east.

Houses on terraced clearings with front yards (khala) used for drying fruit, gatherings, pooja and access to lower houses. Great meeting places (as people pass by) and to spot strangers.

products.

The plan is usually based on a square grid oriented in the east-west direction with the entrance facing east. The layers (public, semi-public, private) are in the north-south direction with the middle private layer being the widest and the others in descending order. The cattle sheds in some cases are placed such that they can be seen while entering the house (a sign of prosperity of the owner). The wash areas are at the rear of the house although there is usually a water container or more recently a water tap at the entrance to wash one's feet before entering the house.

A typical kitchen with sitting clay stove fueled by wood or cow dung cakes.

construction materials and methods

Laterite stone quarried in the area (Sada) is the main material used in most buildings.

foundation

Continuous laterite masonry foundations are made with mud or lime mortar. The use of cement mortar significantly increased in the recent years. Though lime mortar is cheaper and stronger than cement mortar, the preparation is laborious and time consuming and its setting time is four times longer than that of cement mortar. Concrete foundations are also being used in recent constructions due to the development of roads and the availability of expertise in the region. Laterite stone blocks have always been labor intensive due to hand cutting, but machine cut blocks are now available in the area. Freshly cut laterite blocks are usually exposed to weather for a year to "season" them – to make their surface harder and water resistant.

A building site on the sada with material and part plinth.

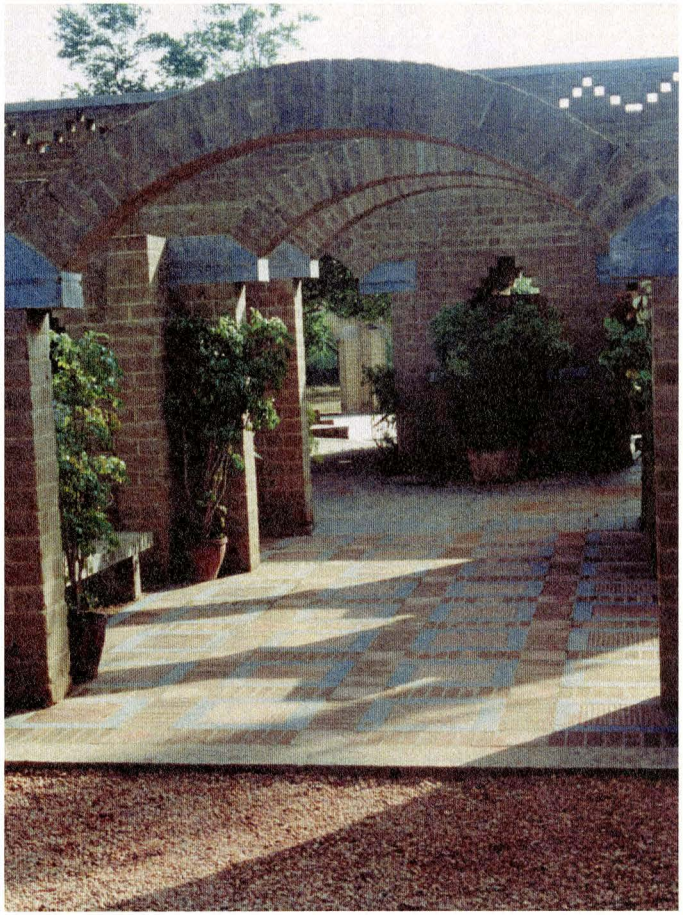
A laterite quarry. Rectangles cut into laterite and pried loose in blocks of 6" thick. building material.

structure

Wood structure: Older houses were built with Teak or Shisham wood. Due to scarcity of teakwood, coconut or jackfruit wood is used for columns and beams. Laterite masonry columns with wooden beams are also common. Laterite being a hard but porous stone is not good for tensile stress. Hence it is only used for lintels with short spans.

Most houses are single story structures with load-bearing walls and sloping wood framed roofs. Therefore the use of columns and beams is not a problem.

Reinforced concrete is limited for the structure in larger institutional buildings.



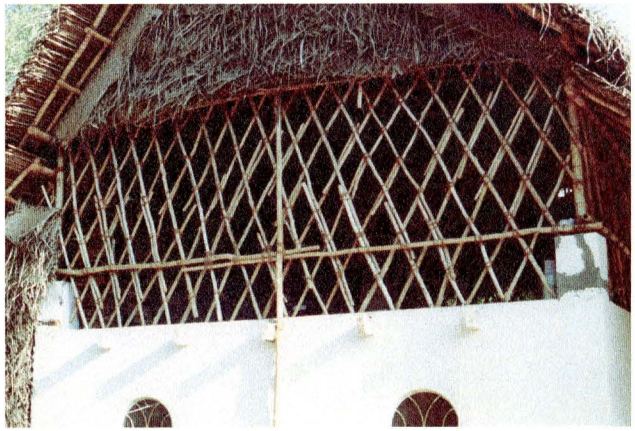
Compressed and sun dried mud-bricks used for building arches and load bearing walls

walls

Reed and mud walls: Mud walls with Karvi (a local reed) or bamboo reinforcement are common. Sometimes the karvi or bamboo is stitched close together with twine and simply plastered with mud or cow dung. These walls are typically used as interior partitions. Exterior walls are thick mud walls or laterite stone masonry.

Load bearing walls are either laterite masonry or sun-dried/burnt brick/ compressed mud blocks with cement and concrete blocks have been used in some structures.

Mud bricks made at an on-site workshop

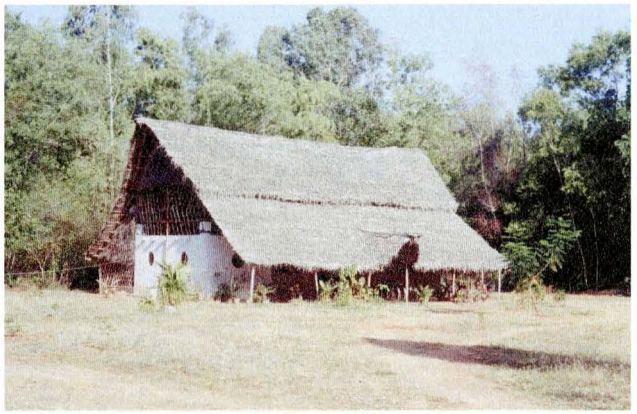


Mud walls with bamboo grills for ventilation with thatched roof

roof

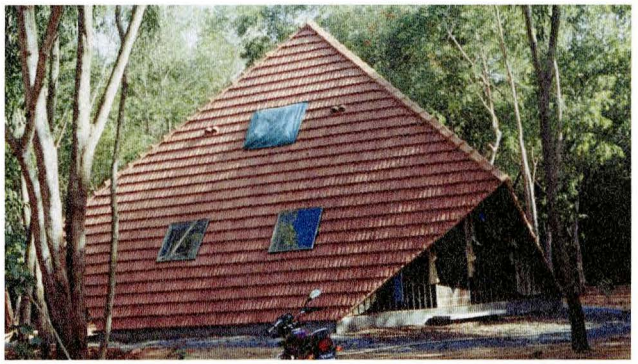
Sloped roofs are a necessity due to the heavy rains. Konkan receives about 300 cm of rainfall each year. Rafters and joists are made of hard wood. Battens are made up of betel nut palm split in four. Mangalore tiles (country tiles) or Nali tiles ('Roman' tiles - cylinders cut in two). The roof tiles and battens are usually changed every 5 to 6 years. However, scarcity of skilled carpenters in the area has led people to want permanent roofing materials. Better wages and permanent jobs have led carpenters to seek work in industries and factories popping up around towns and on the Sada.

Concrete slabs are being widely used in the new constructions. But flat slabs invariably leak after a few years. Sloping slabs require skilled labor not readily available in rural areas. Concrete slabs also get extremely hot in the summer making the interior very uncomfortable. Placing hay blocks on top of slabs is sometimes used for insulation. Mangalore tiles over sloping concrete roofs also works and are aesthetically pleasing.



Thatched roof using palm fronds, for ventilation and coolness.

Thatched roof with bamboo framing over verandah.



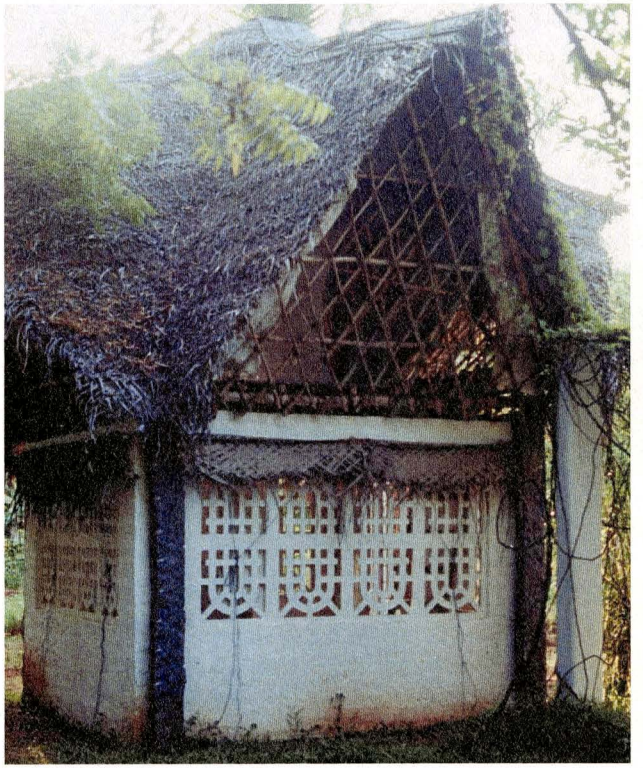
Steep roof with Mangalore tiles.

finishes

Rammed earth with cow dung plaster is typically used as flooring for the ground floor and a new layer of cow dung slurry is applied once a month. The floor gets a texture/pattern when the brush applies the dung and water paste. The cow dung also acts as a natural pesticide. The attic floor is typically wooden. Quarry tiles placed on wooden joists are also used.

Mosaic tiles or cement tiles for flooring are gaining popularity due to their permanent nature. People do not have the need to own cattle any more for milk or farming due to the availability of tractors for farming and dairies for milk. Hence availability of cow dung is a problem. Tiles, though, are not as insulating and obviously more expensive.

Cow-dung plastered floor finish.



Mud plastered walls.

the site

Kumbharmath is a town on the Sada about 6 km from Malvan. It has a school, a post office and a few shops. Ghumda is a small village in a Ghat about 2km from Kumbharmath. This village with a population of about 150 is spread around the temple of Goddess Ghumdaai on the banks of a small stream about 20 feet wide.

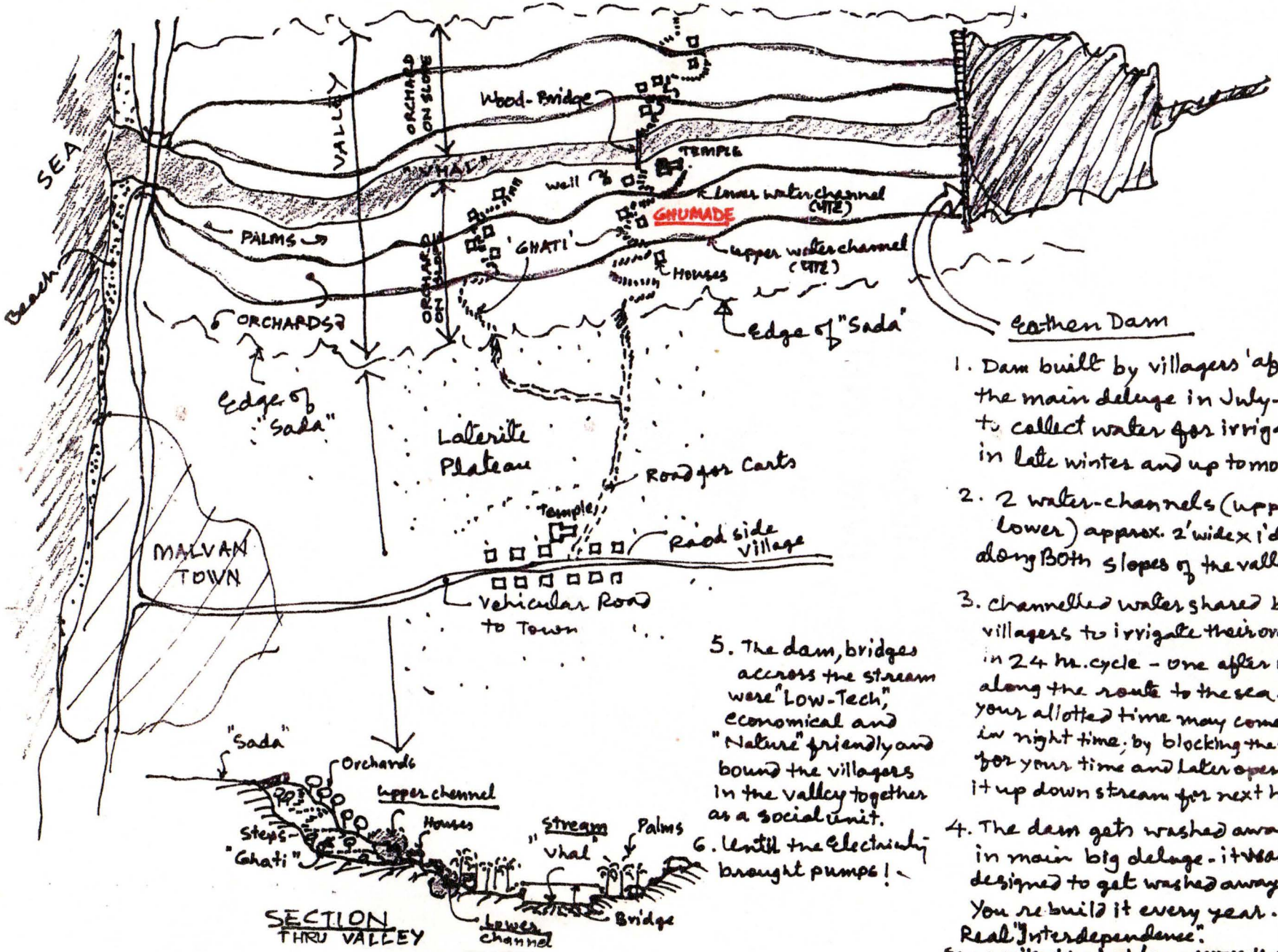
A footbridge links the parts of the village on either side of the stream. Most people living in Ghumda either have their own land, work on somebody's land, work in the few factories coming up recently on the Sada or go to sell their produce in the Malvan markets. A lot of people born and brought up in this village have traditionally migrated to the metropolitan Mumbai, 500 km away.

Ghumda has been recently linked with Kumbharmath by an asphalt road. The village has electricity, telephones and television. There is no government water or drainage system in place. People have their own wells and septic tanks.

Kumbharmath sada with the "mangar" (store on the sada) in background

"Mangar" and a cashew nut tree, rare on the sada in a ditch or natural depression in laterite.

Ghumdaai temple
During a major flood in the 2000 monsoons, waters flowed up to the eave boards of upper roof when the footbridge over the stream (vhal) was destroyed.



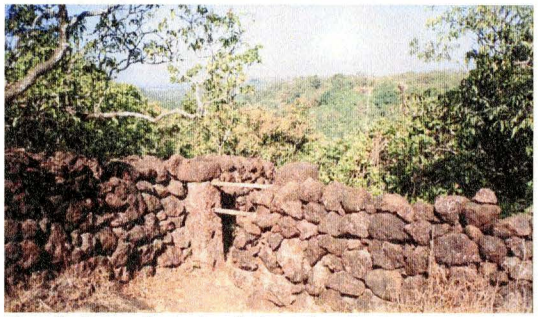
Earthen Dam

1. Dam built by villagers 'after' the main deluge in July- to collect water for irrigation in late winter and up to monsoon
2. 2 water-channels (upper & lower) approx. 2' wide x 1' deep along Both slopes of the valley.
3. channelled water shared by villagers to irrigate their orchards in 24 hr. cycle - one after other along the route to the sea. Even your allotted time may come in night time, by blocking the flow for your time and Later opening it up down stream for next holdin
4. The dam gets washed away in main big deluge - it was designed to get washed away! You re build it every year. Real "Interdependence". Same with the bridge accross the stre
5. The dam, bridges accross the stream were "Low-Tech", economical and "Nature" friendly and bound the villagers in the valley together as a social unit.
6. Until the electricity brought pumps!

Some parts of the sada, which have some layer of topsoil, allow grass to grow. By digging ditches and filling them with soil, trees are planted. But, unless there is a crack below, to drain the ditch, the roots rot.

Detail: Stone compound walls called "gadaga".

Access to the ghati. To the left is an opening with removable bamboo piece for the animals and a narrow opening for people on the right. Wide access at the ghati was for the and unloading of goods onto carts. The goods were later carried on peoples' backs. Now an asphalt road reaches the temple.

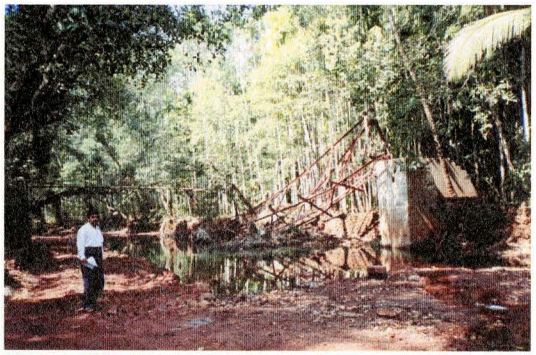


Detail: Entry for animals into the ghati.

Ghati from sada to the Samant house and the temple

Samant son and father in front of the house below with its front yard and covered verandah.

Steps (coming down from asphalt road) to the house. On the left is a stepped retaining wall for the road to the temple.



The government steel concrete bridge was washed away in the floods when floating tree trunks rammed the center support-piers and broke it in pieces.

A temporary footbridge has again been installed (appropriate technology?) over the vhal, built by villagers as they used to do every year 'after' the floods. It represents a low-cost, low-tech, environmentally friendly solution.

the existing house

The Samant house is a picturesque traditional house about 200 yards from the Ghumdaai temple. It sits about a 50 feet off the plain and 250 feet below the Sada on the Ghati.

It belongs to a well-to-do educated Samant family who own about 50 acres of the surrounding land. Until recently Mr. Samant had been working as the head of the village committee for the past 20 years.

The house is about 150 years old, made of wood columns and mud walls. The foundation and stem walls are laterite stone and lime mortar. The sloping roof is country tiles on wood framing. The floor is compacted mud with cow dung finish. It is a single story house with an attic. The attic is mostly used as storage for coconuts, betel nuts and mangoes during season.

The house is equipped with modern utilities such as a television set, refrigerator, telephone, etc. An on-site biogas plant produces natural gas for cooking. The plant processes cow dung, which, when combined with certain bacteria produces gas, which is then piped into the cooking range.

Entrance passage to the existing house from the east through the cattle sheds.

Front elevation with the "khala" and the covered verandah with wooden grills

Roof view of the house with the back yard and dense plantation.

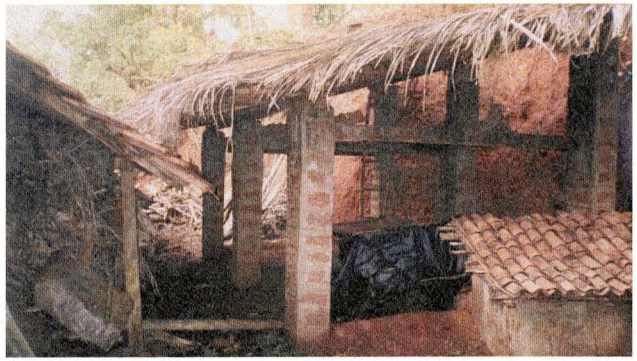
Traditional cooking fuel such as dry wood and cow dung cakes sometimes supplement the biogas.

Water from an on-site well is pumped up to the overhead water tank and there is running water in the kitchen and wash areas. The toilets are a separate structure at the back of the house with a septic tank.

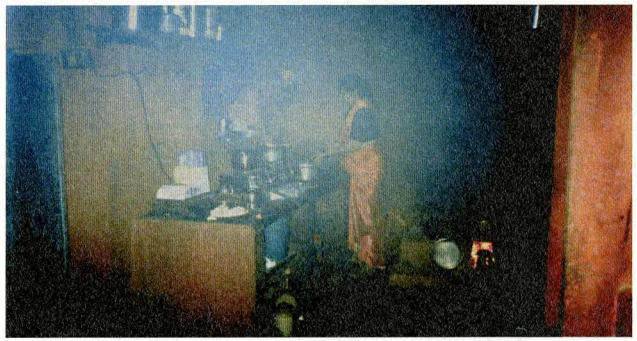
The plantation is now being irrigated by a Drip-irrigation system, replacing the traditional water channel network. The channels though are kept in operational condition for irrigating the neighbors' plantations in drier months.

There is no artificial HVAC system, but the mud walls and the design of the house help the interior stay cool during summer. Electric ceiling fans offer a lot of ventilation on a very hot and humid day.

Entrance passage to the khala of the existing house from the east leads through the cattle sheds. The cattle shed houses the half a dozen or so cows and buffalo that provide milk and cow dung for the biogas plant. The buffalo are used for rice farming during the monsoon seasons.



Gobar gas (bio-gas) plant next to the south side of the house consisting of three chambers.



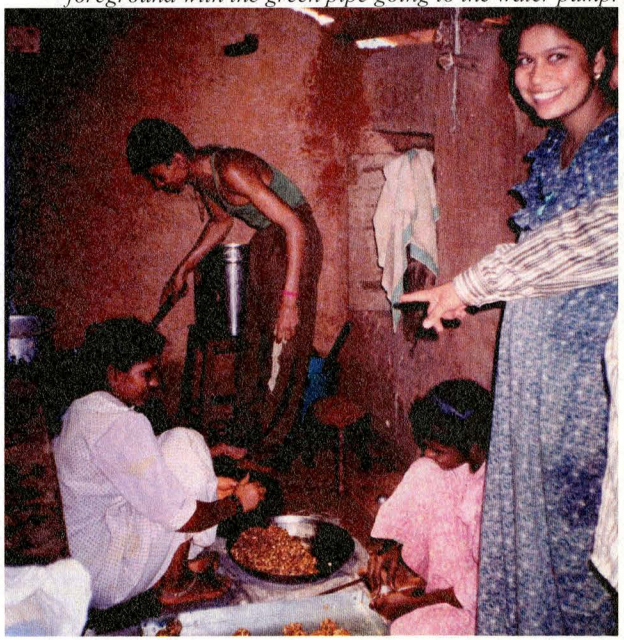
Smokey kitchen with a combination of the old and new.

Central main room with wooden stairs going to the attic.

dozen or so cows and buffalo that provide milk and cow dung for the biogas plant. The buffalo are used for rice farming during the monsoon seasons.

The rear verandah is now used as a small-scale factory to make native food products sold commercially. The space is tight and the existing house is expected to be needed soon for the growing business.

Looking back at the house from the northwest, the well is in the foreground with the green pipe going to the water pump.



The rear verandah has been adapted as a workshop.

Panoramic view of the existing house with the Ghumdaai temple in the background, The structure in the foreground is the cattle shed which is to be demolished.

program

The existing house will be adapted to serve as a factory to produce local food products and store farm products. Parts of the house need to undergo change, as new materials will be introduced to solve existing problems and provide for the new programmatic needs.

A new house will be designed next to the old house creating a live and work environment. The design program includes a modest house, about 1500 sq.ft. to suit the lifestyle of the users.

The design will respond to the site conditions and the immediate environs in a contemporary fashion while maintaining a balanced relationship between the aspirations of the family and the culture, tradition and vernacular architecture of the region.

Materials and method of construction design should allow the to respect the customs and traditions of the local land as well as respond to the changing lifestyle and requirements. Use of local materials and cost effective, available technology is important. The house needs to be well ventilated and comfortable without the use

Looking back towards the home, young plants stabilize the slope and an unused upper 'pat' (irrigation channel) for water is on the right of walkway. The black irrigation pipe now substitutes for the 'pat'.

of HVAC system.

The proposal integrates the two structures into a single scheme with exterior spaces devoted to live and work functions.

Steps going down from behind the bathroom to the lower 'pat' now unused, lead to the well.

the project

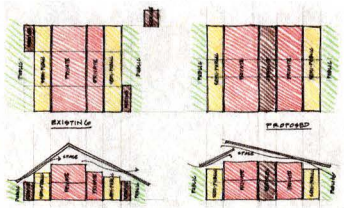
The orientation of the site is such that the north side faces the valley while the slope and trees protect the south side. The entrance is on the east as desired. The breeze from the sea in the west comes in along the stream and turns due to the shape of the valley to enter the site from the north. There are excellent views of the temple and the plantation along the stream (vhal) on the north side.

The pedestrian entry is from the south whereas the vehicular entry can be from the south at a higher level or from the east. The site to the east of the existing house is perfect due to its orientation as it faces east and the existing khala becomes a courtyard retaining its use.

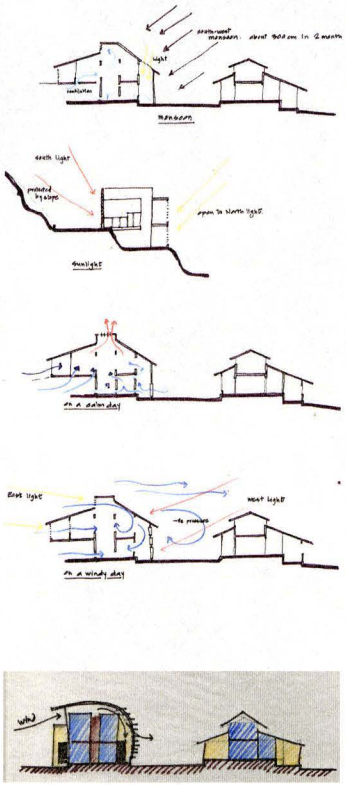
The new khala is at a higher level accessible from the road and being on the east of the new house can then be linked to this courtyard creating an interesting interlock of open spaces.

The circulation between the open spaces and the new house maintains the access from the courtyard to the temple and the plantation level.

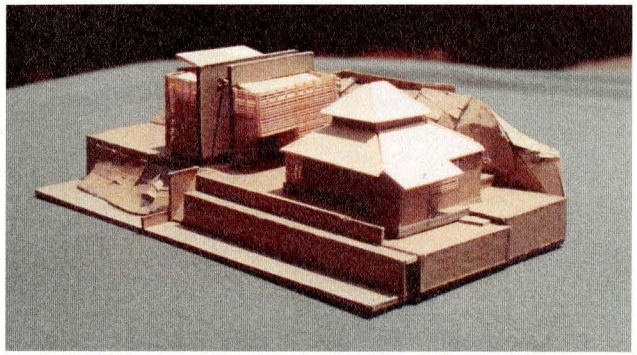
site studies



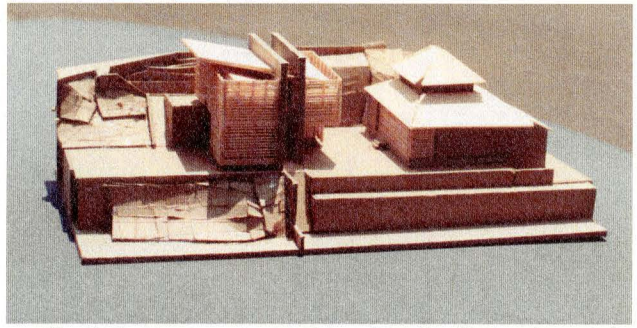
transition spaces



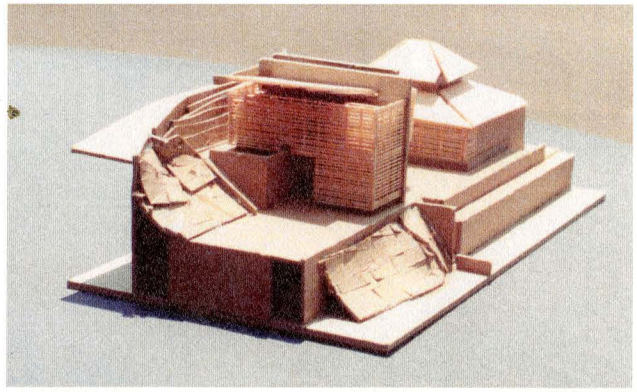
wind and light studies

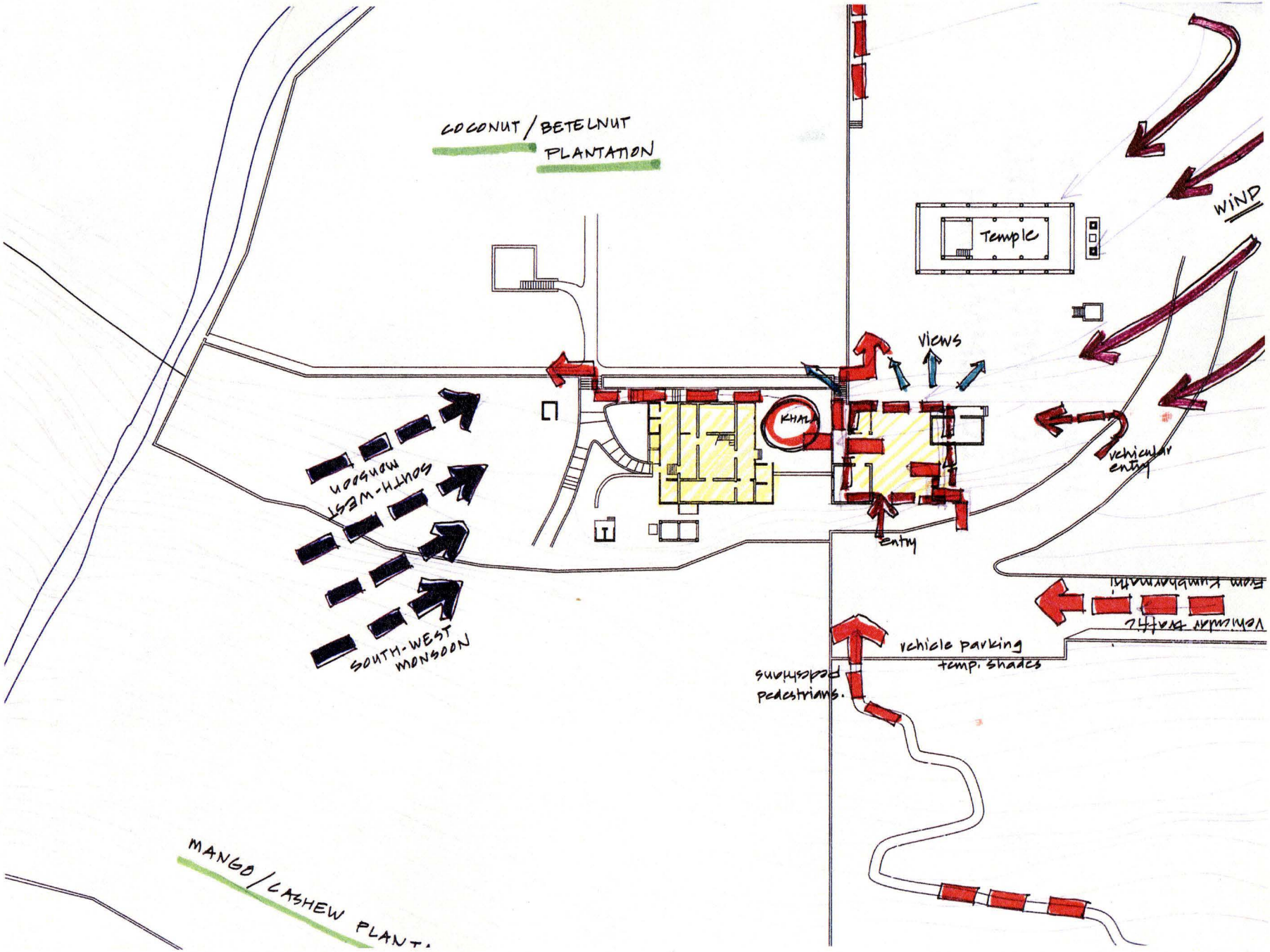


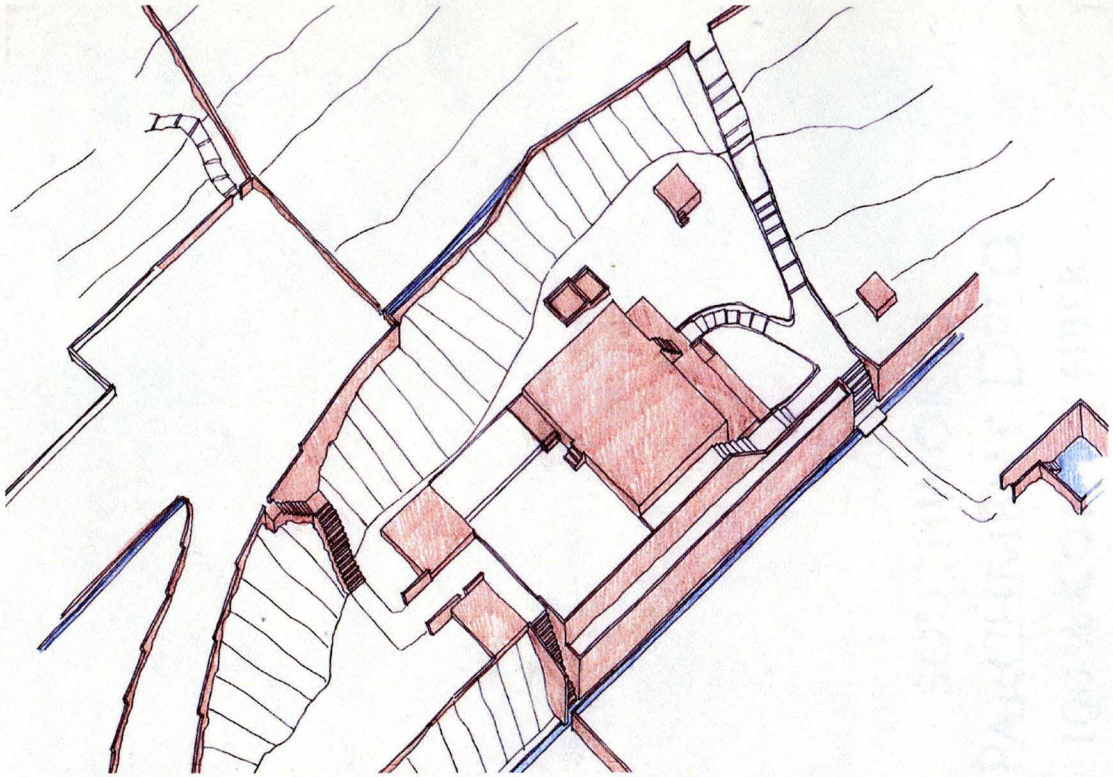
Study 1:The design proposal uses the existing site language of the "gadaga" to organize the circulation between the public and private spaces



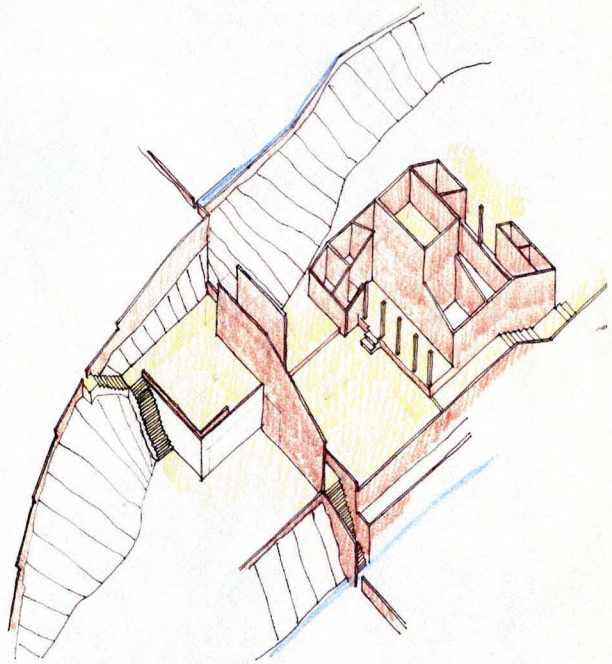
The design is a transparent box of wooden lovers that can be opened and closed to facilitate ventilation. The box is saddled over the walls that arise off the boundary walls and run north south from the sada to the vhal.



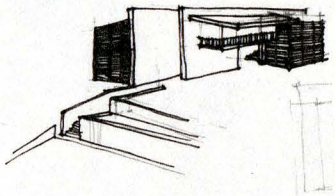

COCONUT / BETELNUT PLANTATION
WIND
Temple
views
KHAL
vehicular entry
entry
SOUTH-WEST MONSOON
SOUTH-WEST MONSOON
vehicle parking
temp. shades
pedestrians.
MANGO / CASHEW PLANT.

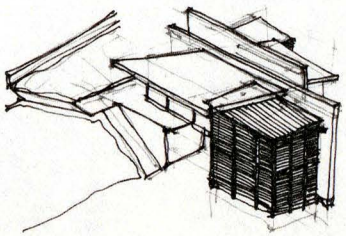


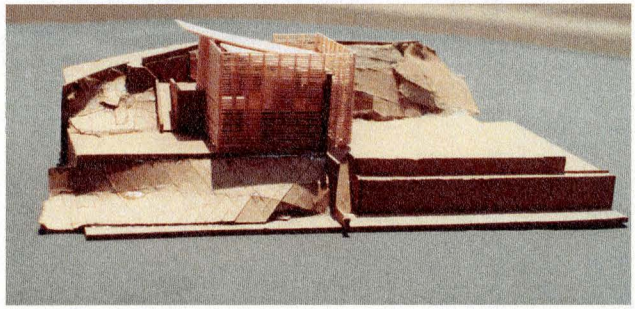
An axonometric study of the existing levels and retaining walls showing irrigation canals (the upper "pat" and the lower "pat) and the lines of the "gadaga" (stone boundary wall).



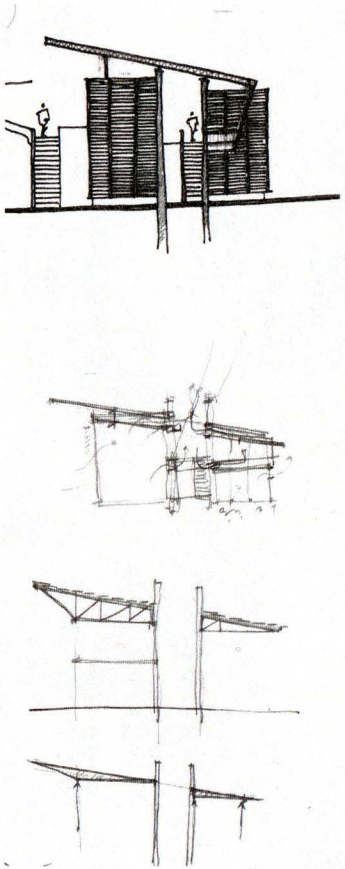
Axonometric study of the relationship between the existing house and the beginnings of the new house.







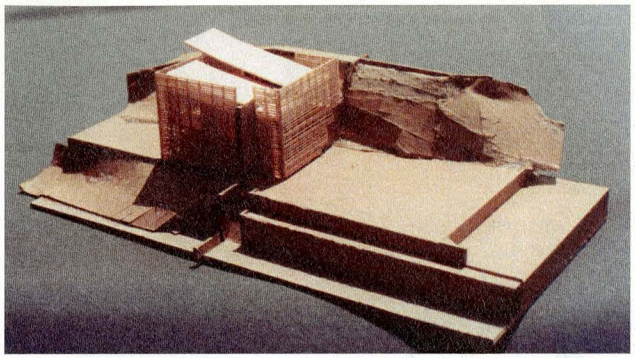
Study 2: the box is simplified to work as a screen over the structure. The boundary walls dictate the overall circulation in a subtle way

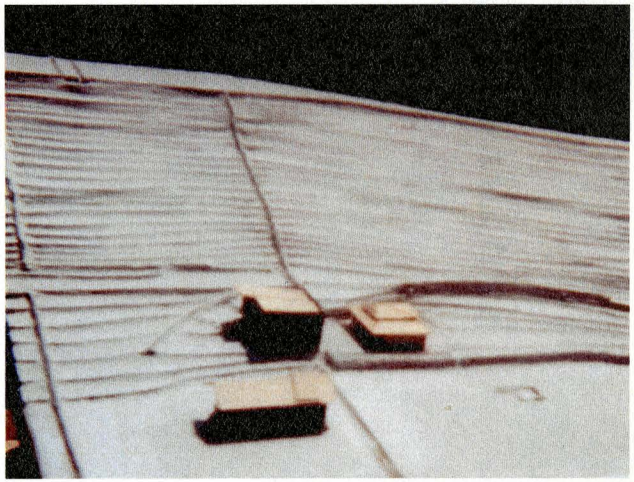


roof plane

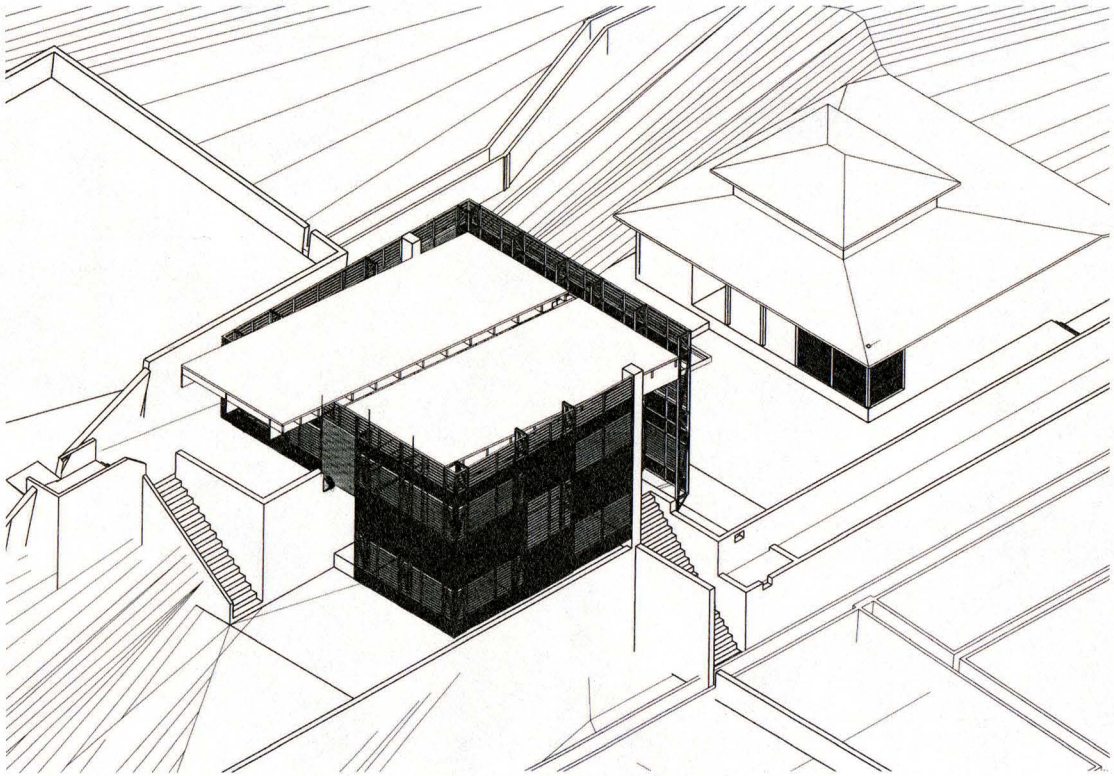
Due to the changing lifestyle of the family from exposure to television and city life, there have been major changes in the planning of the interior spaces. Although the traditional transition spaces have been maintained the introduction of indoor plumbing requires some deviation from the traditional layout. The need for privacy and designated spaces for sleeping and dining, require the layout to change from a common central room layout to a more rooms-connected-by-hallway layout. The recent introduction of television has also had an impact on the activities and space utilization in the house.

The design thus responds to the site conditions, its immediate environs and the aspirations of the family in a contemporary fashion while maintaining a bond with the culture and traditions that are so ingrained in everyday life as well as with the vernacular architecture of the region.

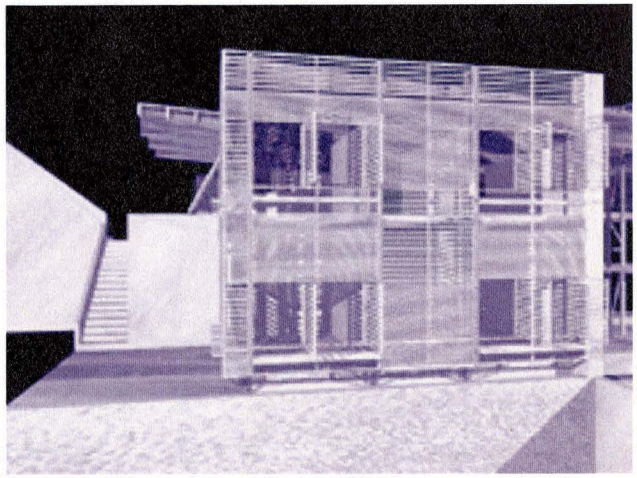




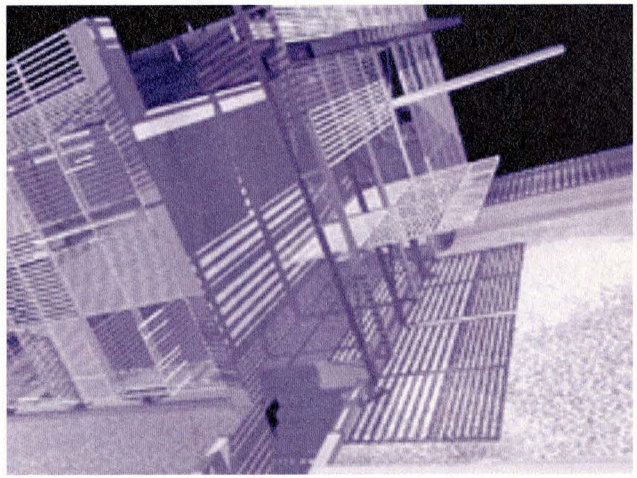
Site topography model with the temple and the site features.



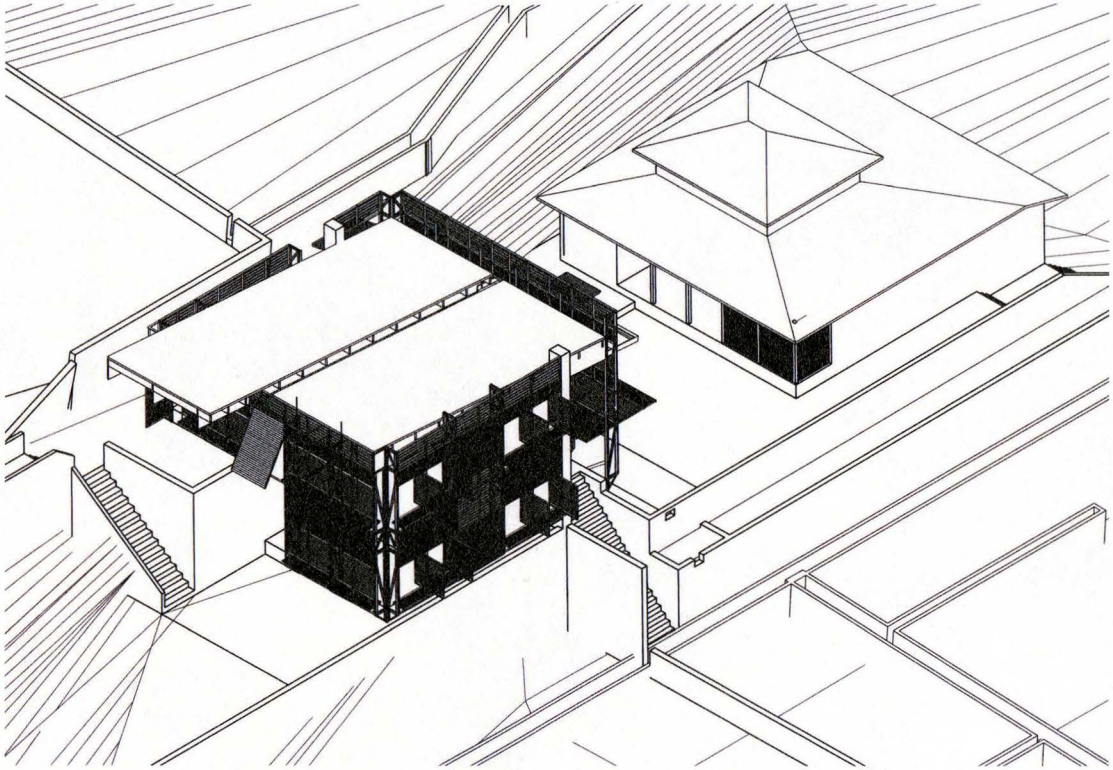
North east isometric view of the house with all the screens in closed position



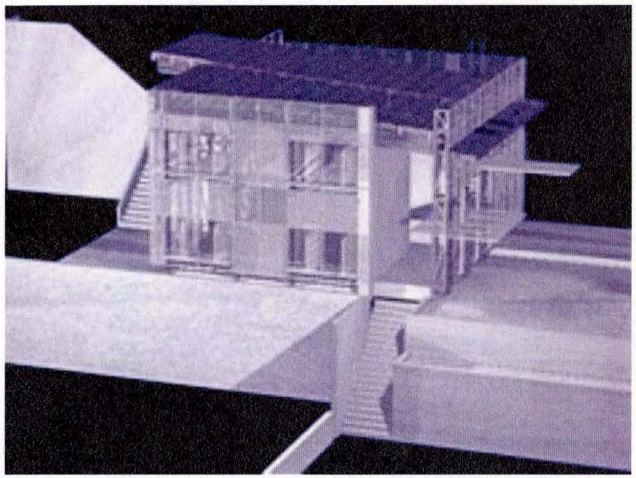
North elevation



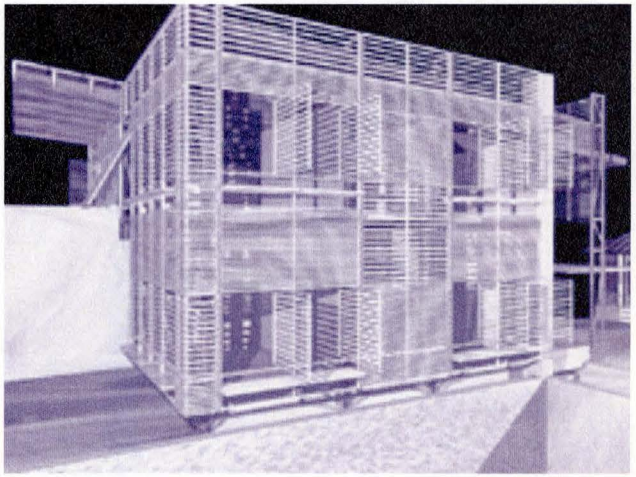
East side entrance to the new house



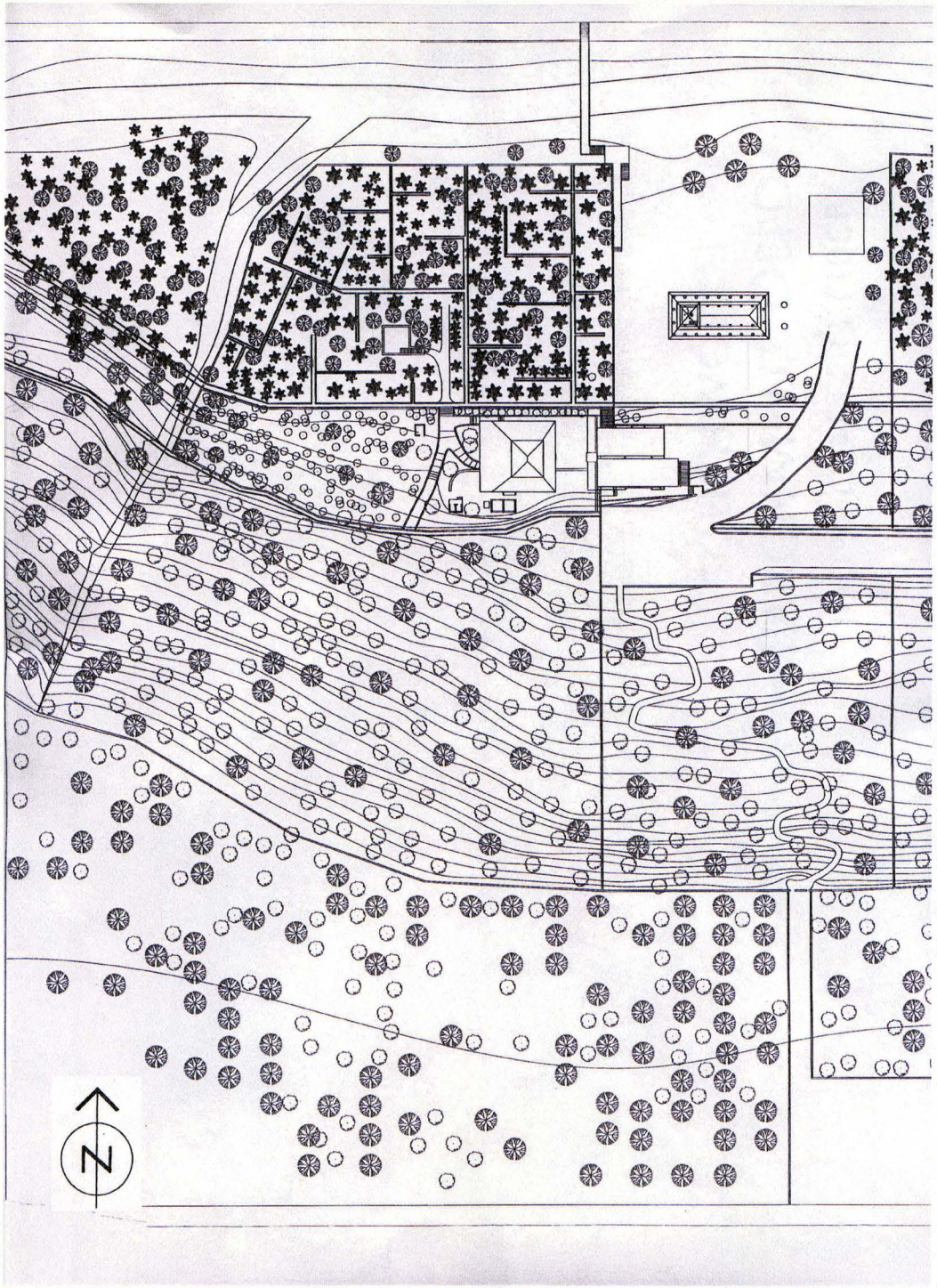
North east isometric view of the house with some screens in open position



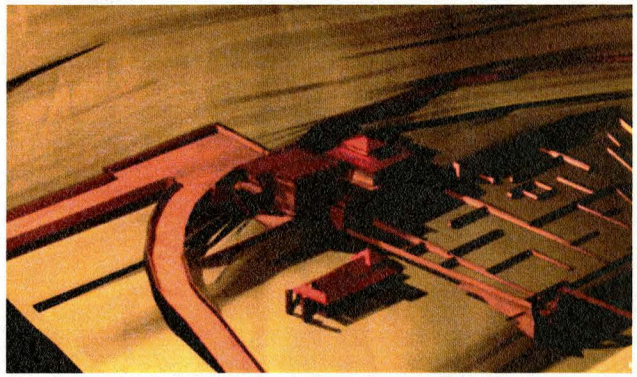
North west view



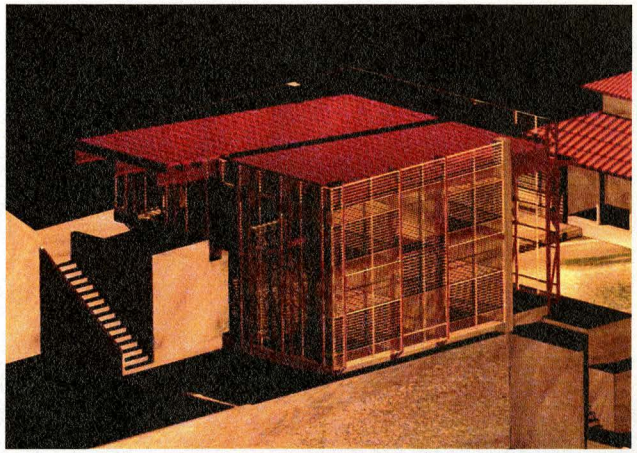
North east eye level view



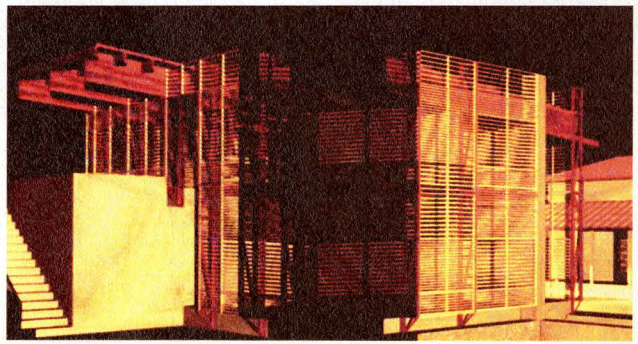
A



Birds eye view of the site including the temple in the foreground

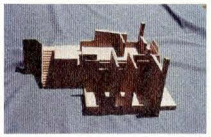
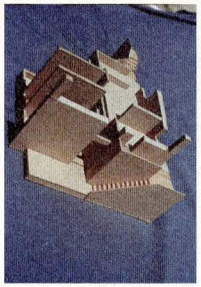
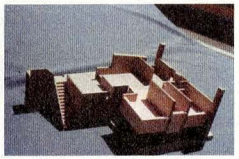
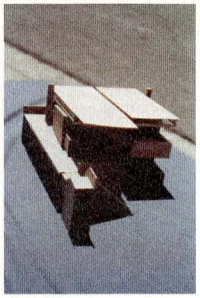


View of the new house

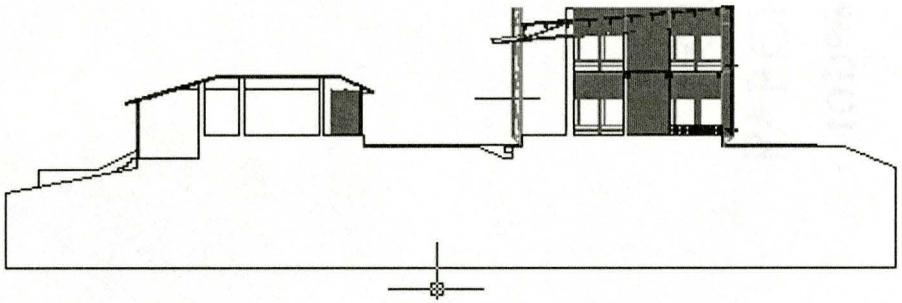


A partial section through the north-east corner

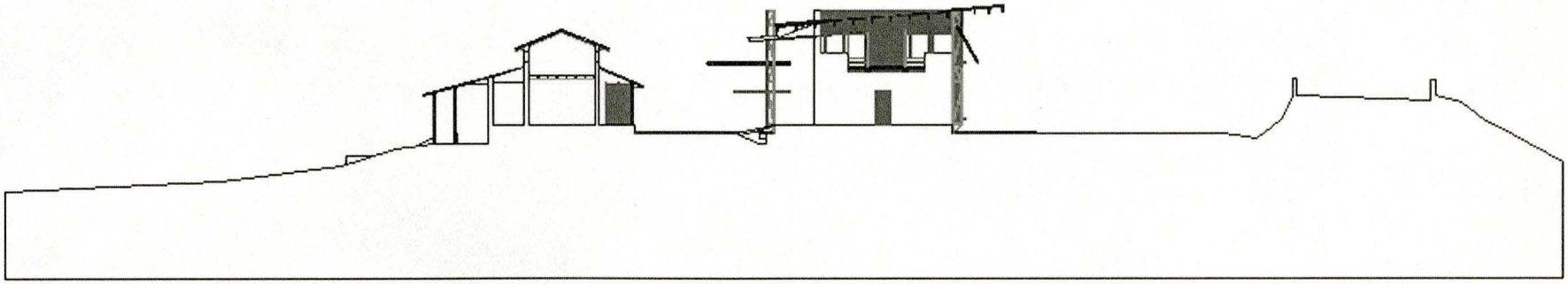
A. Site plan.

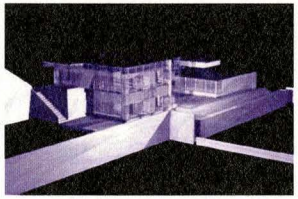
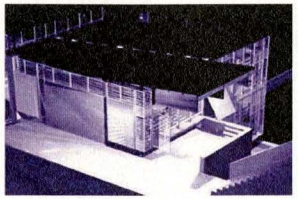
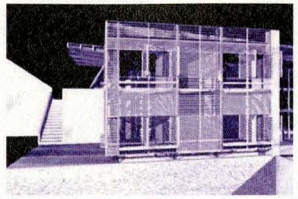
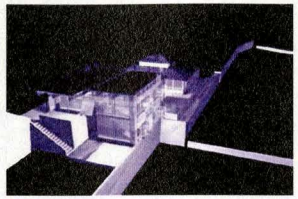
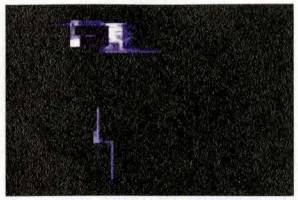
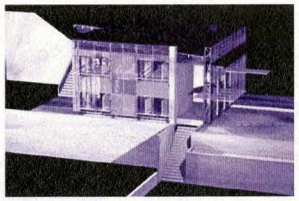
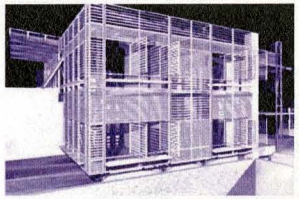
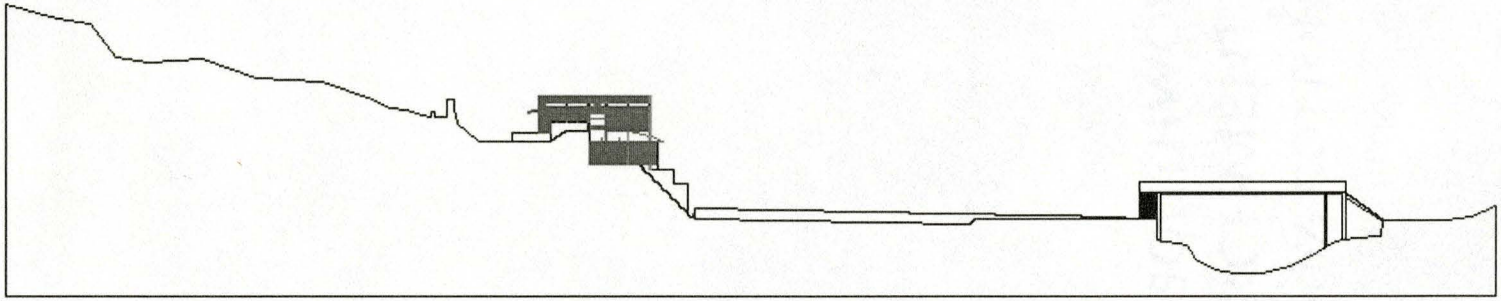




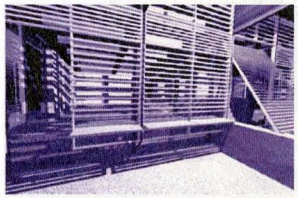
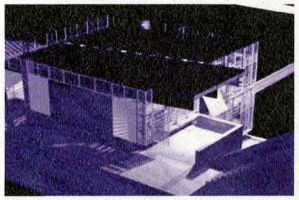
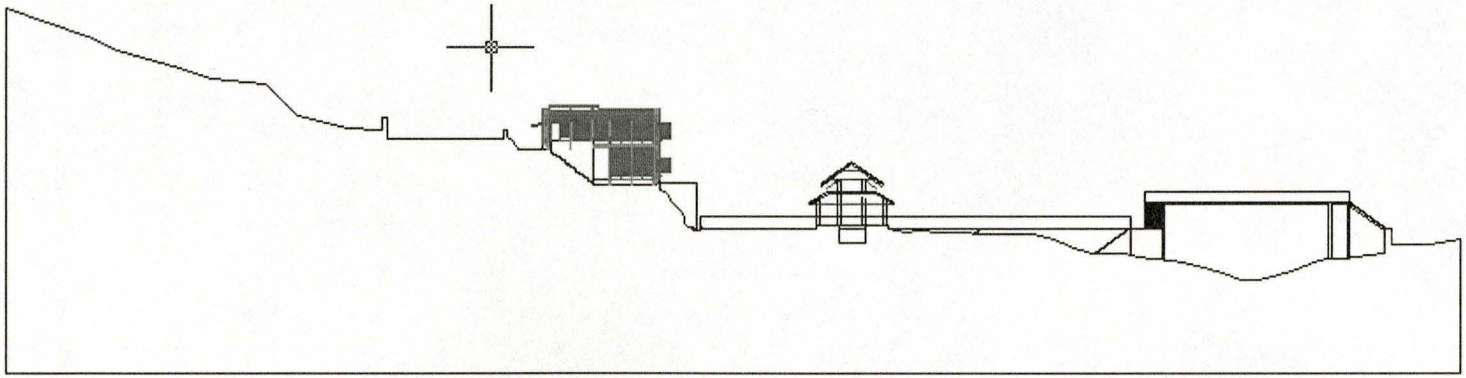
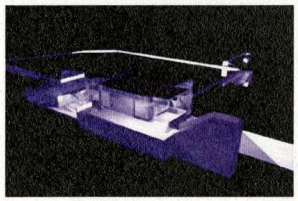
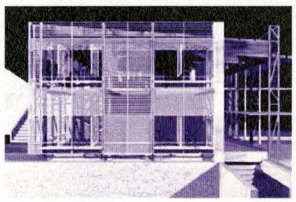
Section E-W



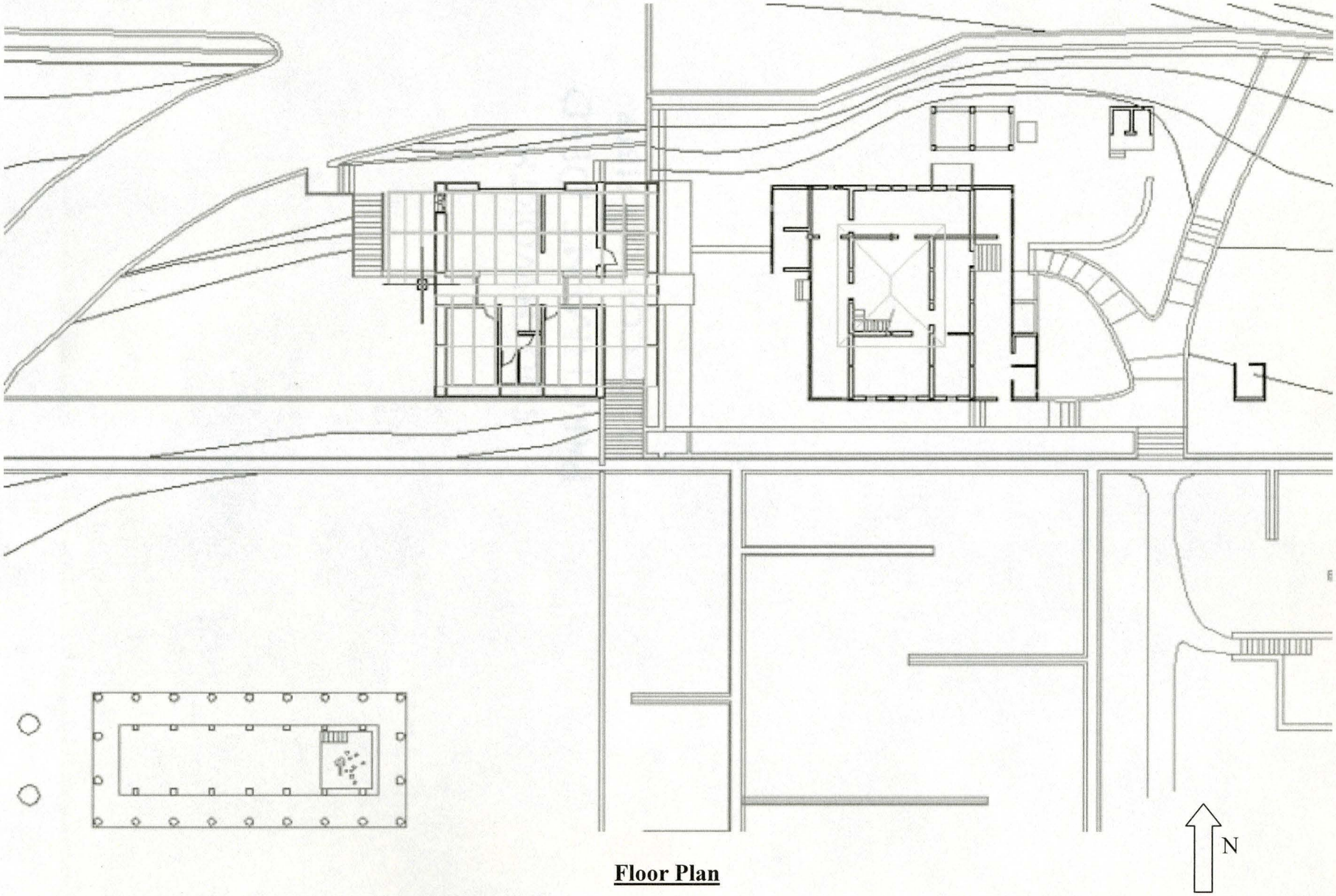
Section N-S

Site Section 1-1

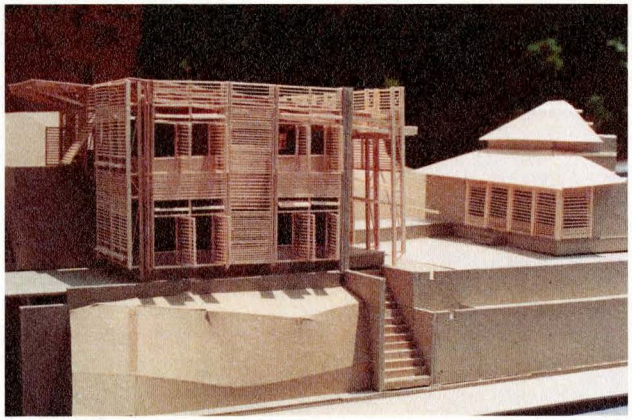






Site Section 2-2



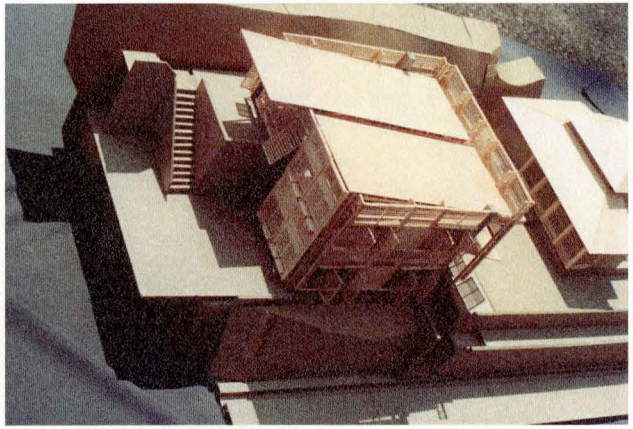
Floor Plan

project model

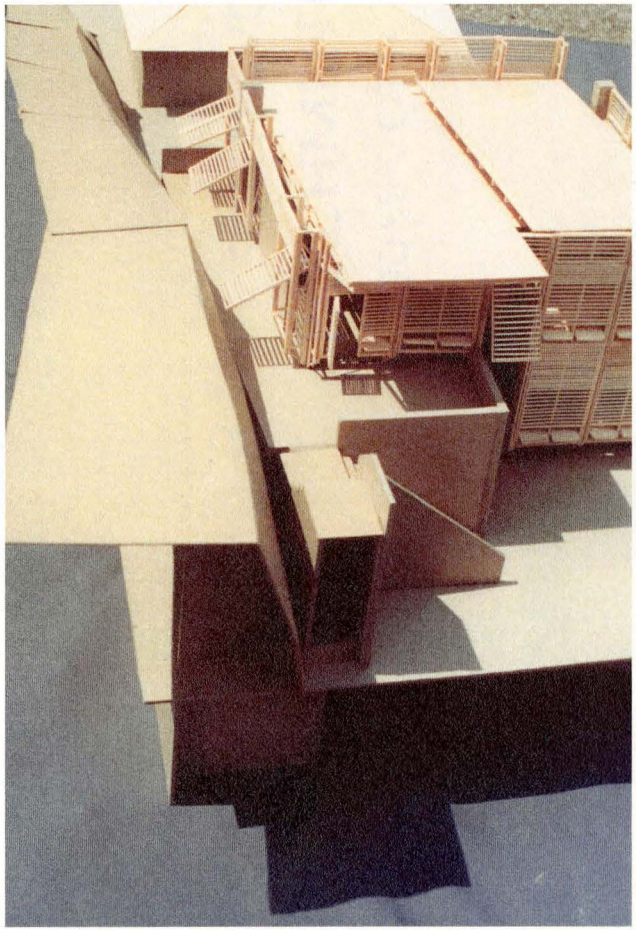


North Elevation

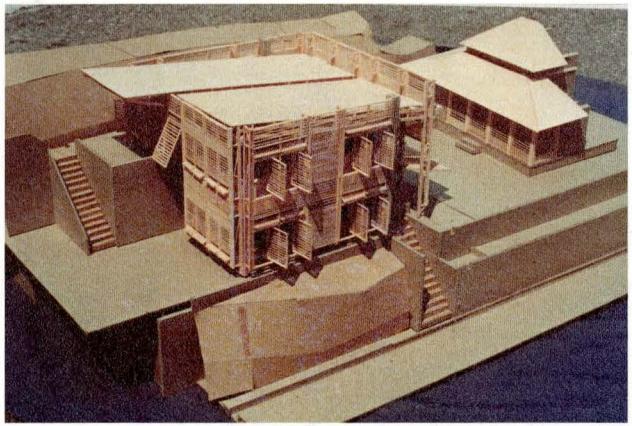
North-East Side with entrance



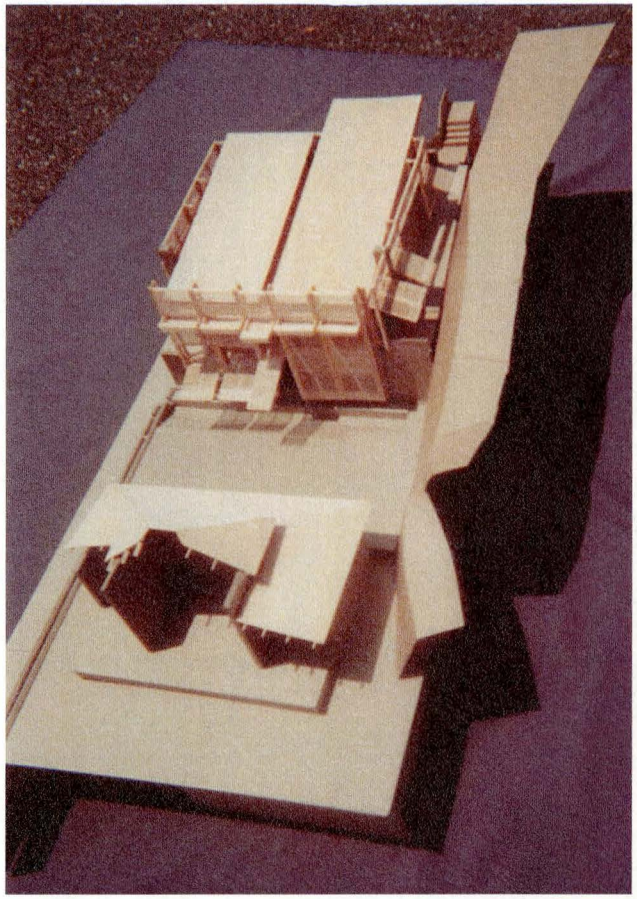
North-East birds eye view

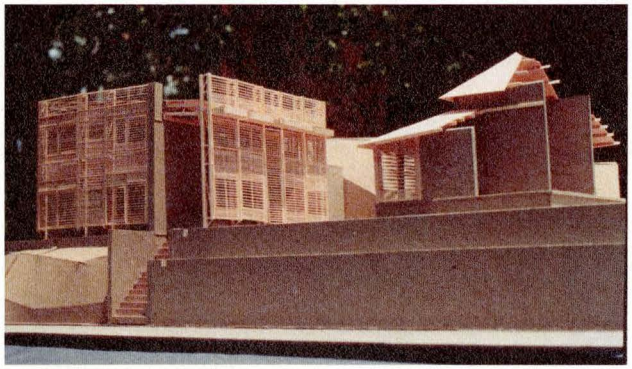


East View with the new khala



North East view





North West eye-level view

South West roof view with the courtyard