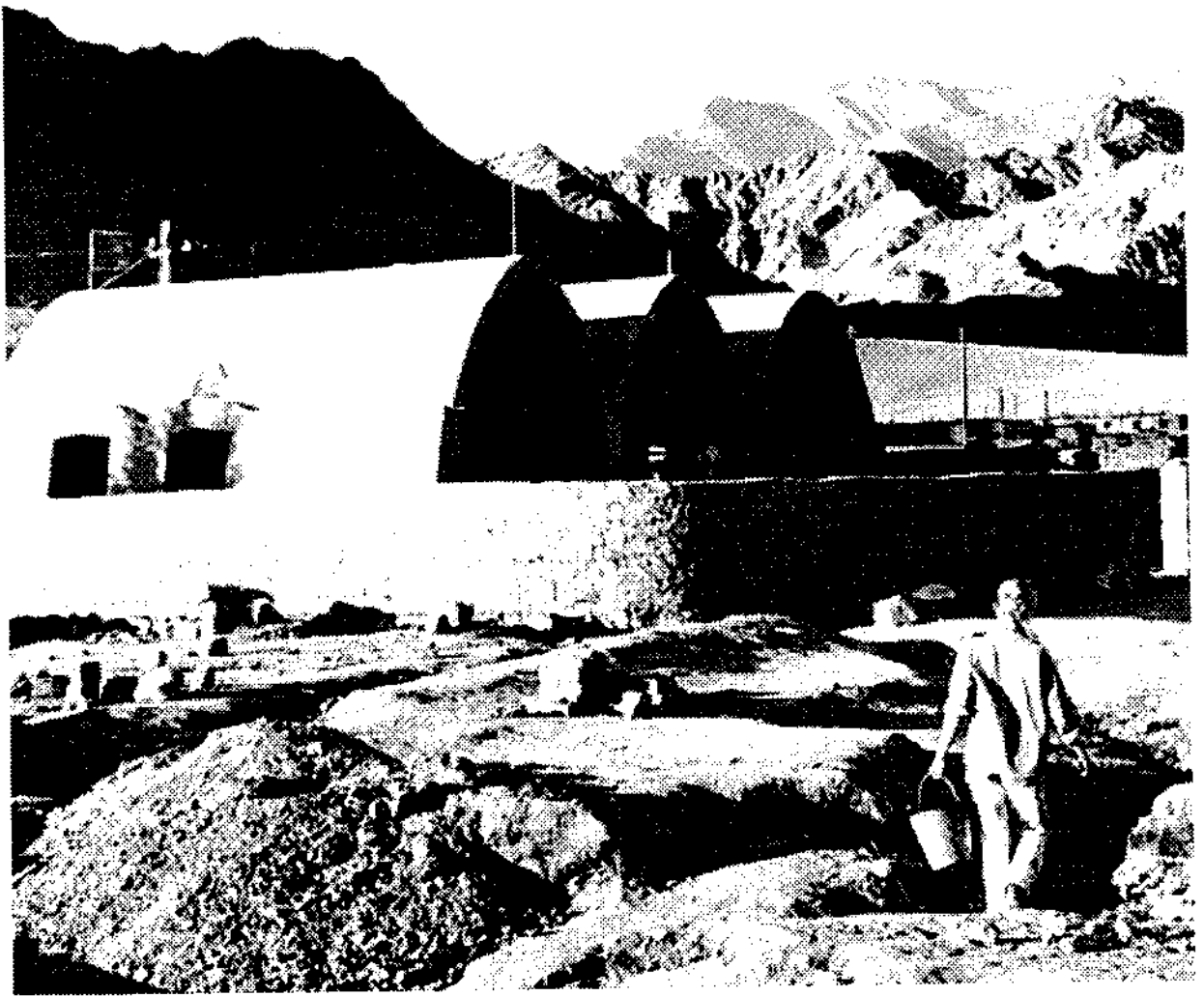




BUILDING WITH EARTH

THE NUBIAN ARCH AND THE PARABOLA HOUSE



The lack of timber and wood products has become a serious threat to both local and global survival in many parts of the world.

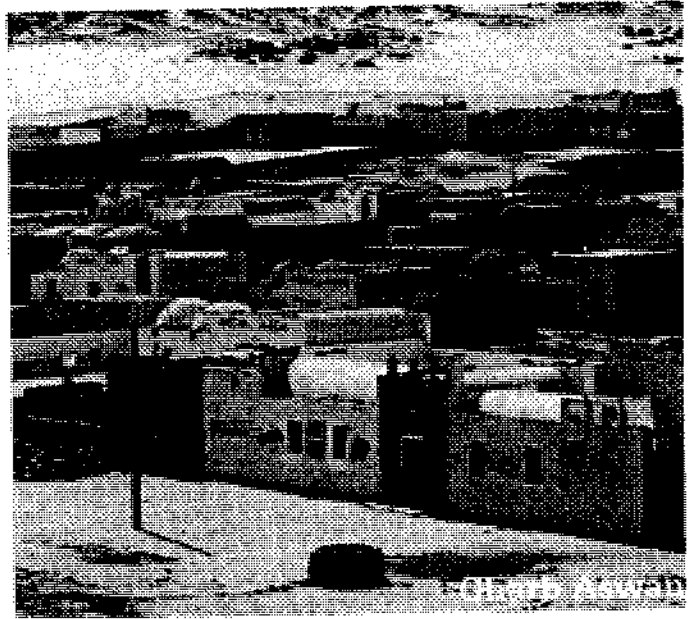


DIB recommends "The Nubian Arch", illustrated here from a Danida financed pilotproject in Ladakh, Northern India in 1986, as an effective step towards combatting this development.

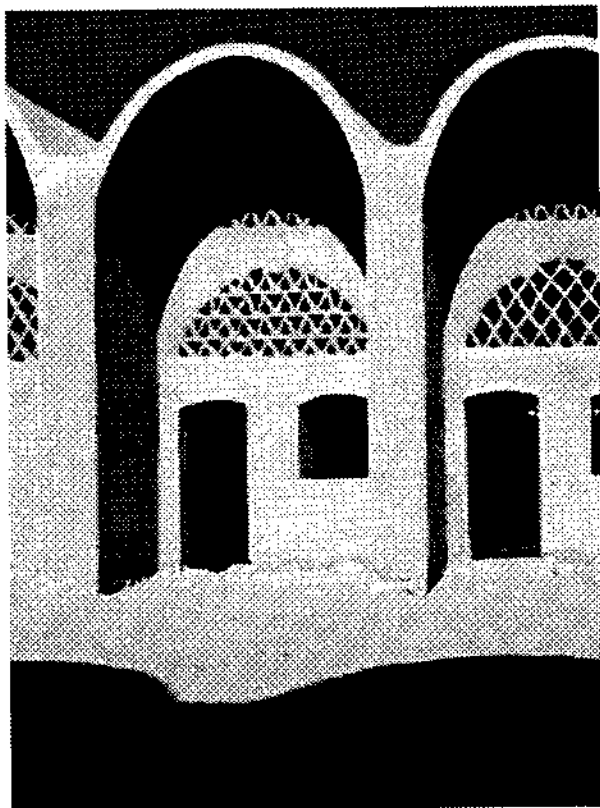
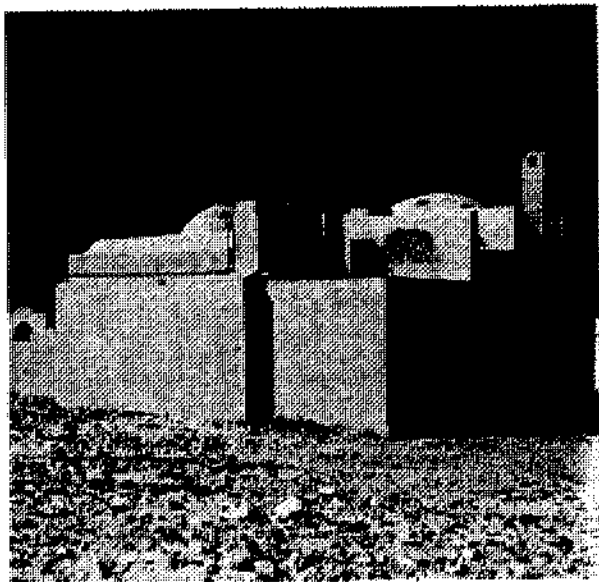
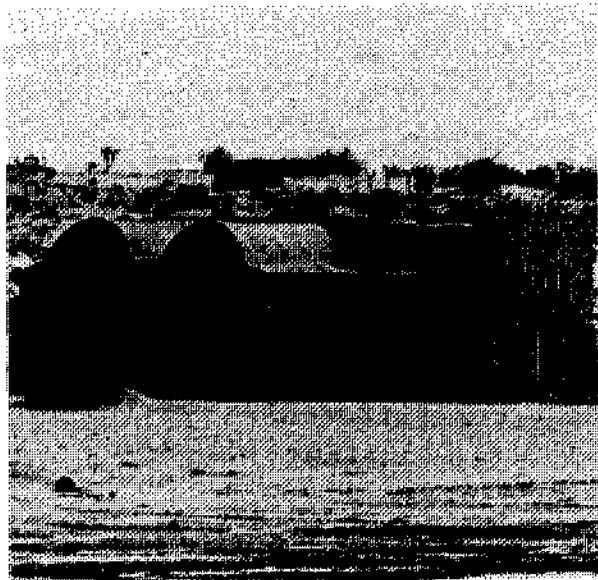
The Nubian Arch has its origin in ancient Egypt, where it can be traced back 6000 years.

The construction is carefully described by Hassan Fathy, the Egyptian architect, in his book "Architecture for the Poor".

Some of Fathy's applications of this construction is reproduced here from the book.



The Nubian Arch is a parabola-shaped selfbearing construction of sunbaked earth blocks, which makes it possible with the help of simple bricklaying technique to erect a complete corehouse with walls and roof exclusively using earth materials.



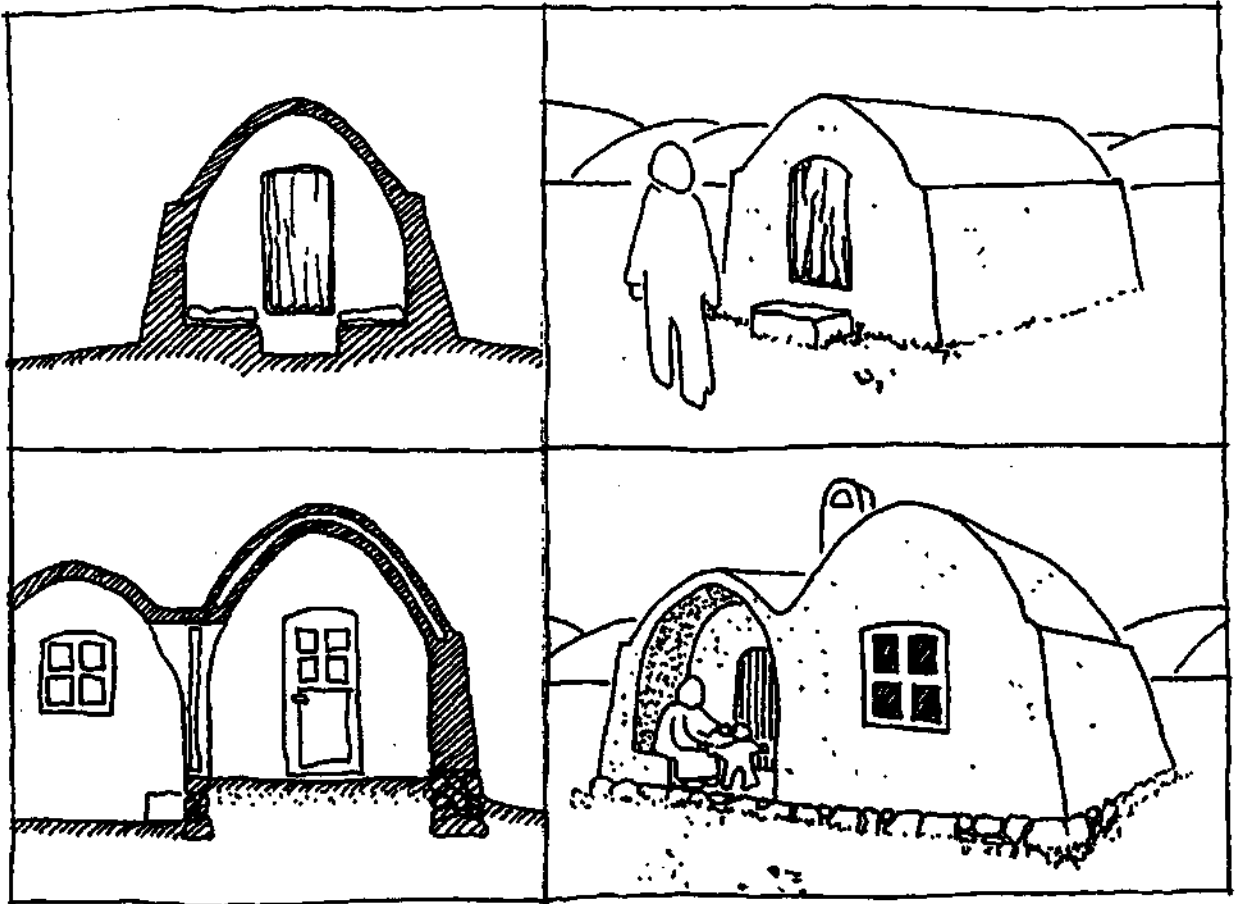
New houses Khartoum (El-Hasan, Bahy)

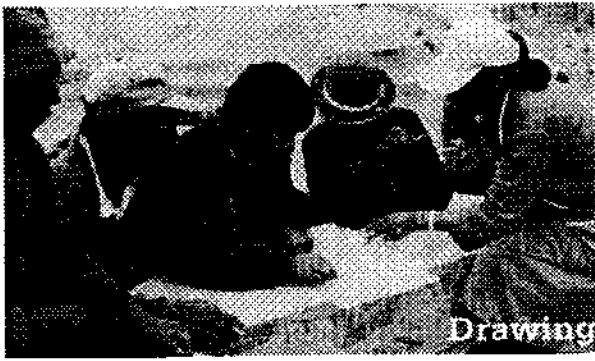
PARBOLAHOUSES

We call houses built with the Nubian arch as the roofconstruction "Parbola houses".

A very simple parabolahouse can principally be built entirely without capital. A solution which may be particularly relevant in a relief situation.

A more sophisticated type could be an extension of one of these relief houses. For example as illustrated here with an insulated roof, wooden doors and windows, dampcourse and foundation.





Drawing



Preparing earth



Preparing straw



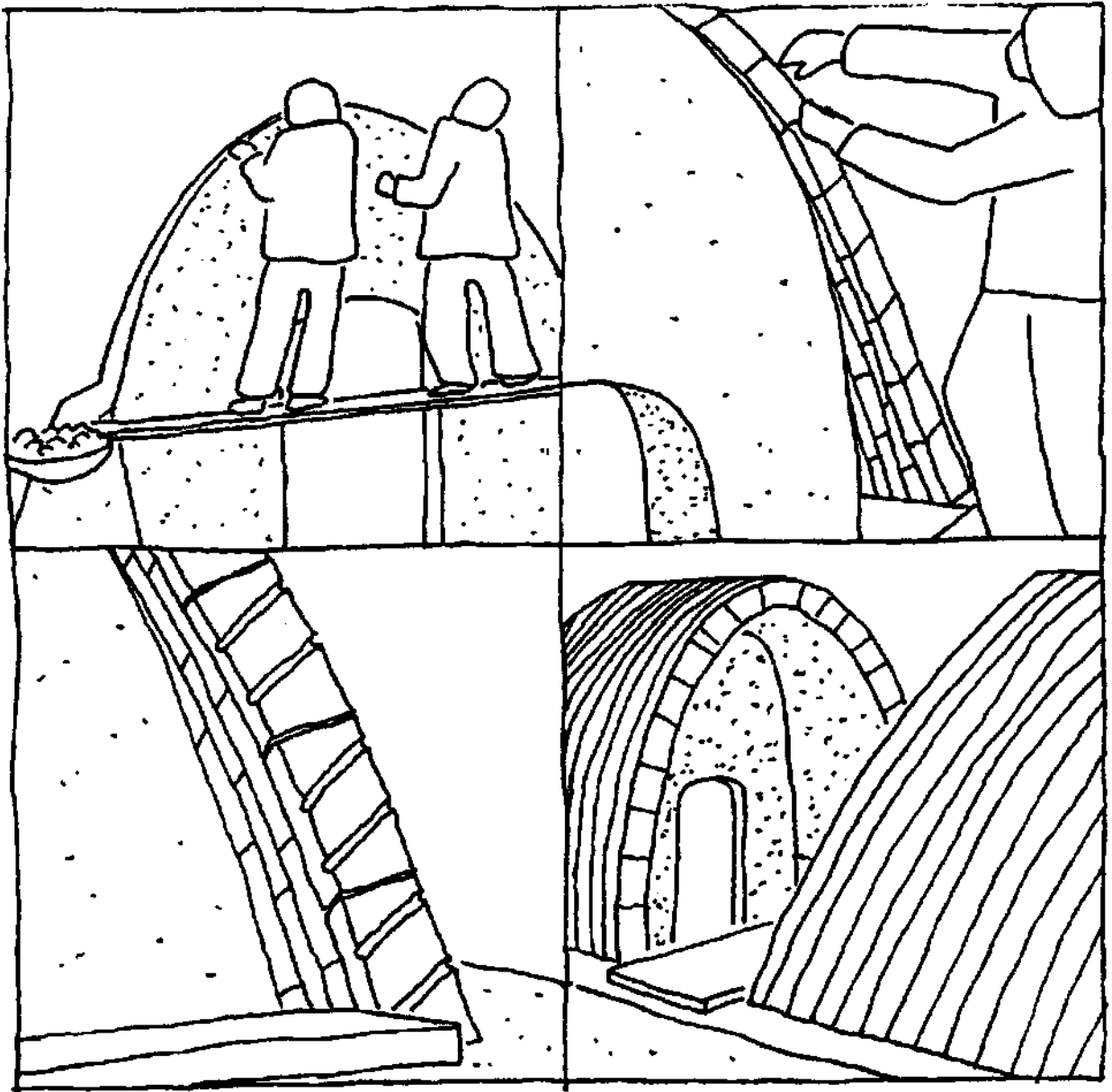
Building foundation



Production of blocks

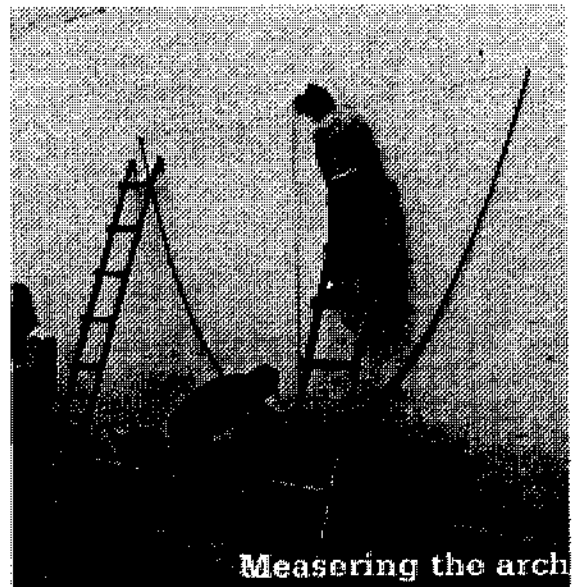


Building walls

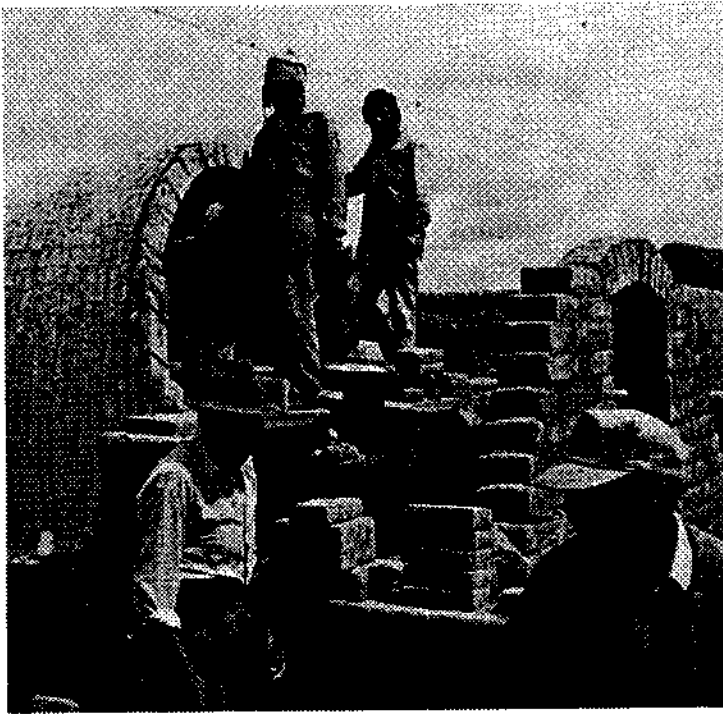
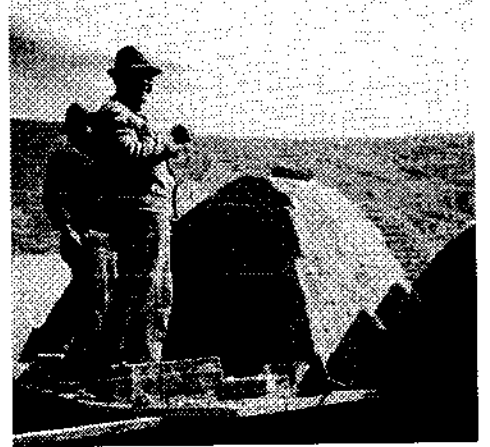


BRICKLAYING TECHNIQUE

1.
A parabolashaped endwall with the desired height of the arch is built.
2.
The arch is laid with an oblique angled course.
3.
The stones to be used must be made with patterned surface.
4.
Bricklaying can be done simultaneously from both endwalls.

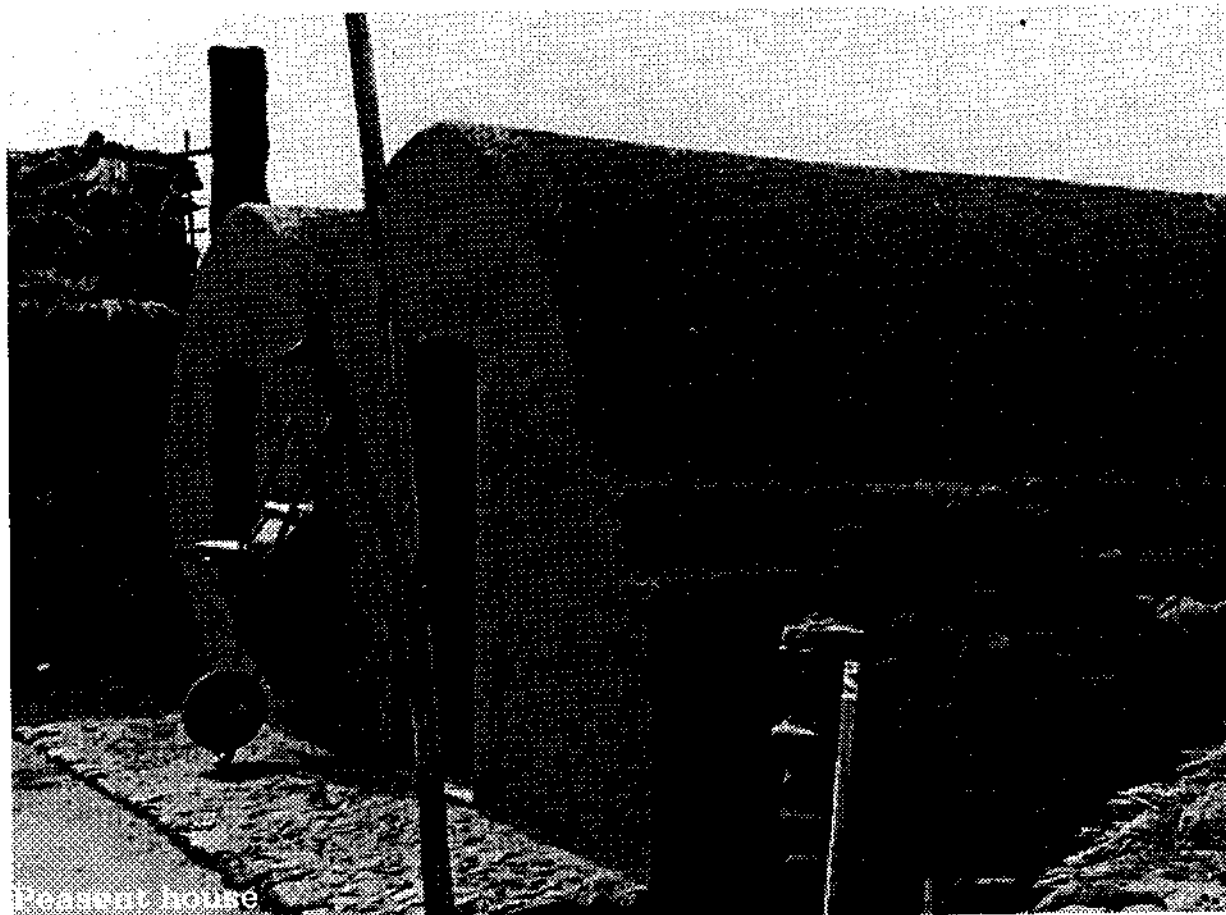
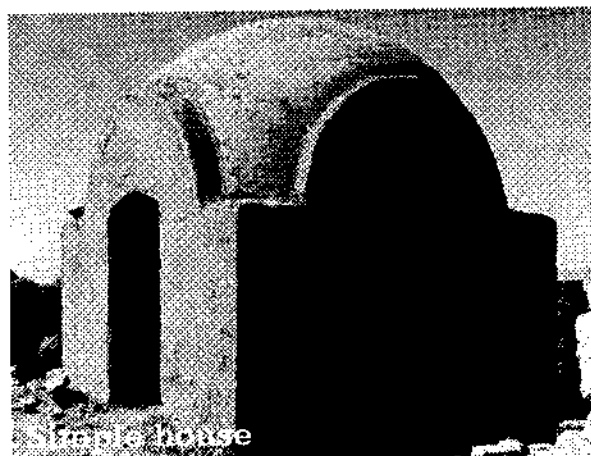
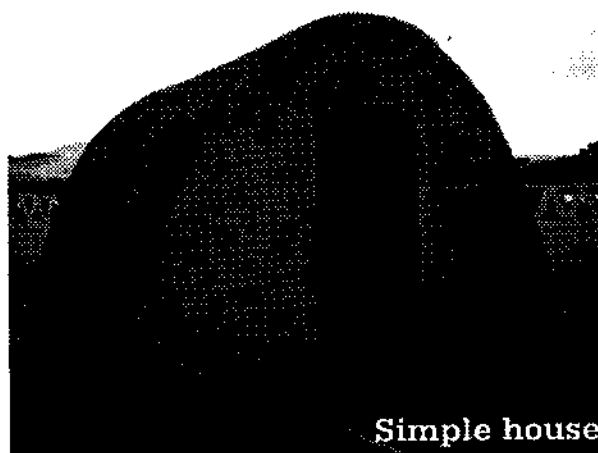


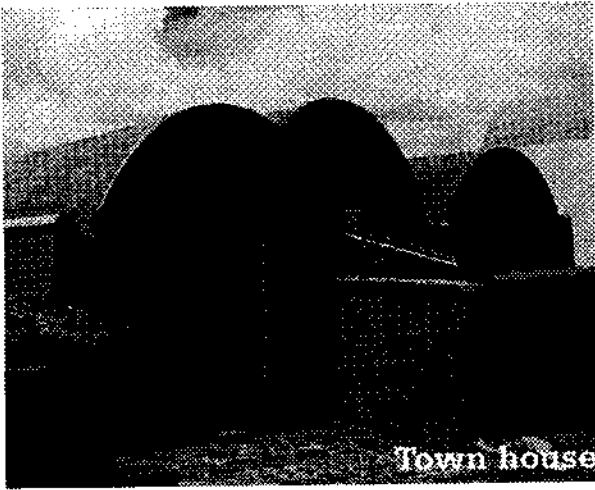
Measuring the arch



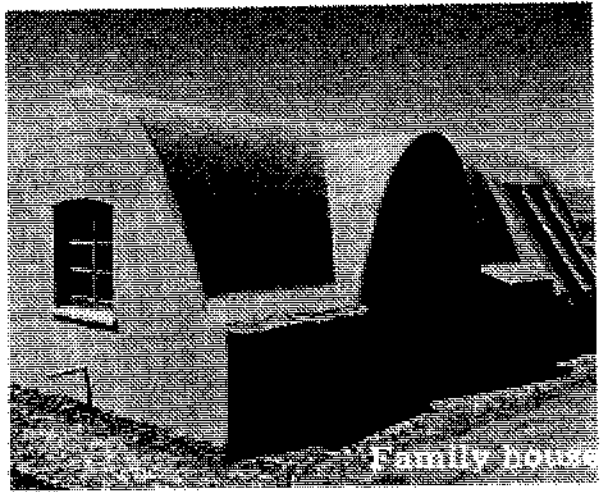
From the year 1990 in conjunction with the Bolivian NGO- CEPRODES, and a group of homeless former mineworkers and peasants, DIB is carrying out a Danida financed housingprogramme. Different housetypes are being erected , ranking from the very simple relief house to more advanced homes on two floors, schools and health centres.

The houses are built within the economic guidelines of UNCHS Habitat housing programme in Bolivia, and experiences have shown that the most basic house can be erected as do-it-yourself projects for less than half the cost of building traditional low-cost houses in the area.

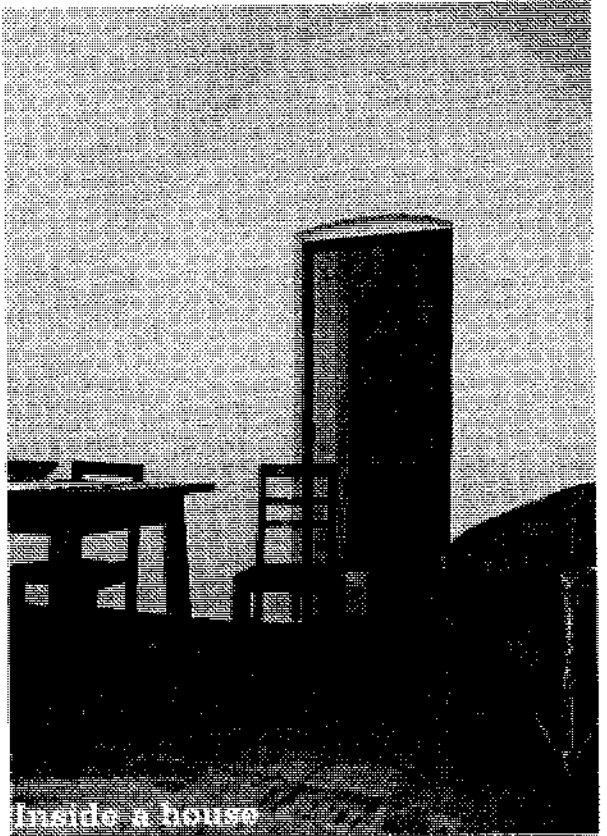
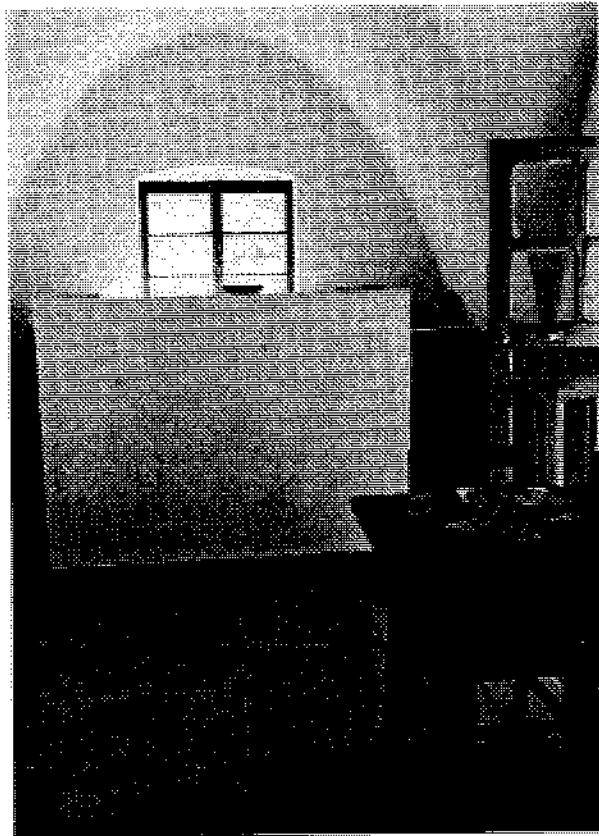




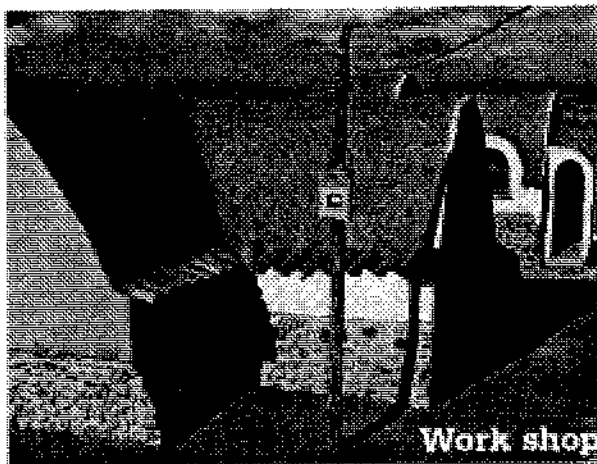
Town house



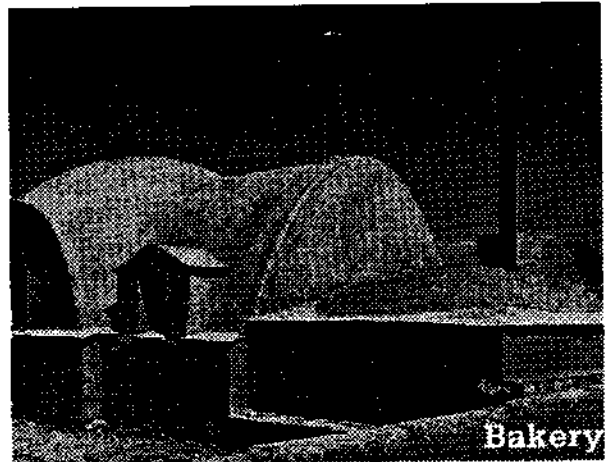
Family house



Inside a house



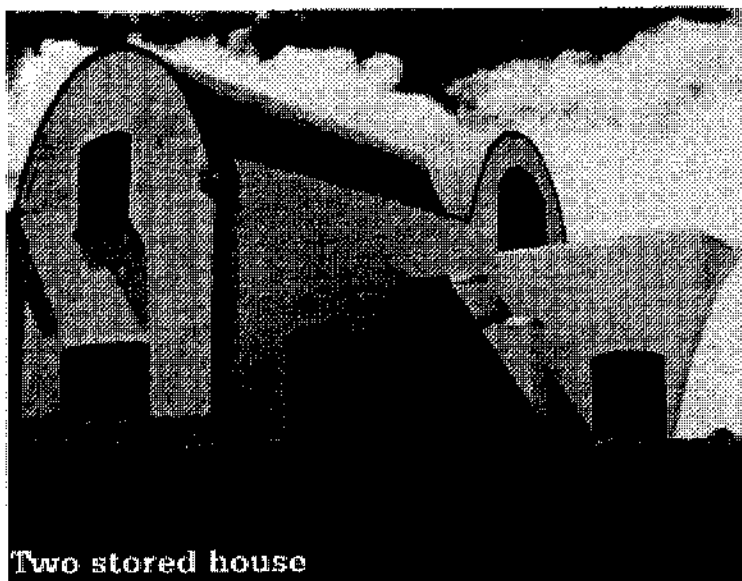
Work shop



Bakery



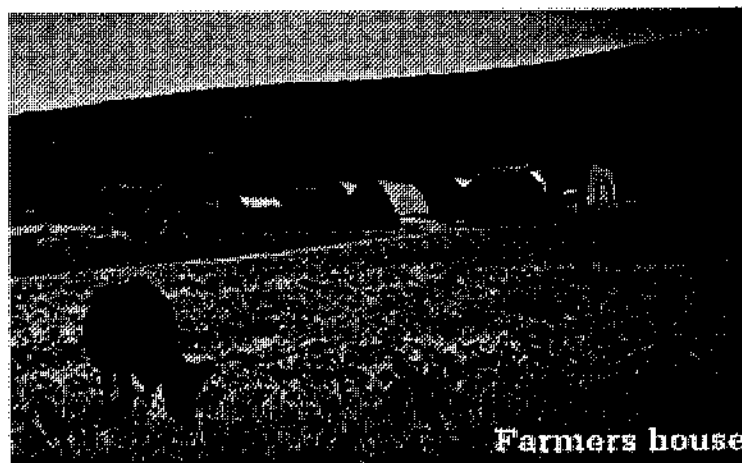
School



Two stored house



From the school



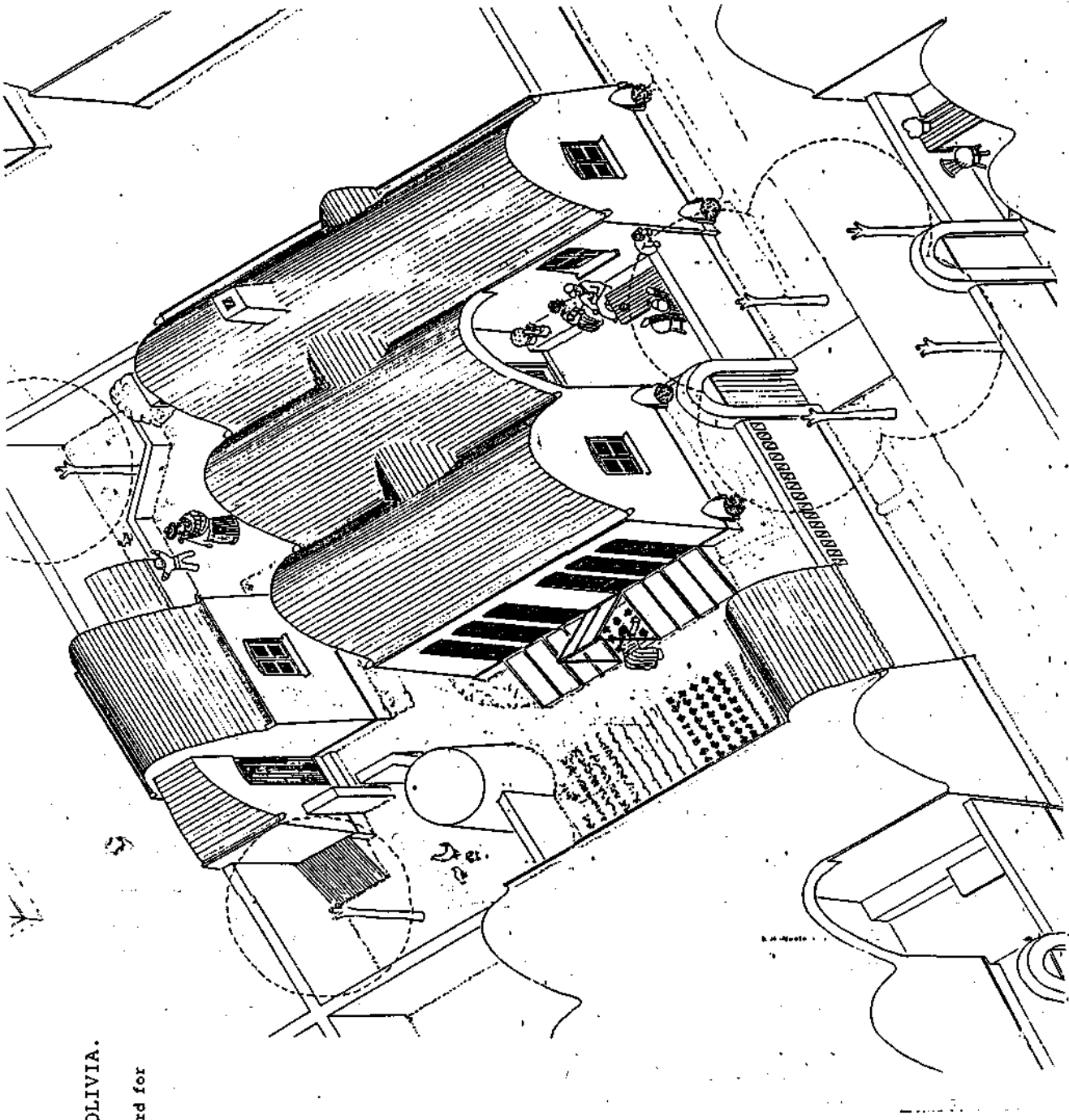
Farmers house

DIB offers to lead and plan similar pilot- and demonstration projects with parabolahouses, and accompanying education- and documentation programmes.

DIB cooperate directly with local private organisations and other institutions in recipient countries.

PILOT PROJECT FOR CONSTRUCTION OF
ADOBE HOUSES IN THE HIGHLAND OF BOLIVIA.

Project for improvement of the living standard for
resettled miners in Machacamarca Oruru.



The project is prepared by Danish
International Settlement Service.

Machacamarca

The target group is an agricultural cooperative for resettled miners in Machacamarca in the centre of the highland of Bolivia called Altiplano.

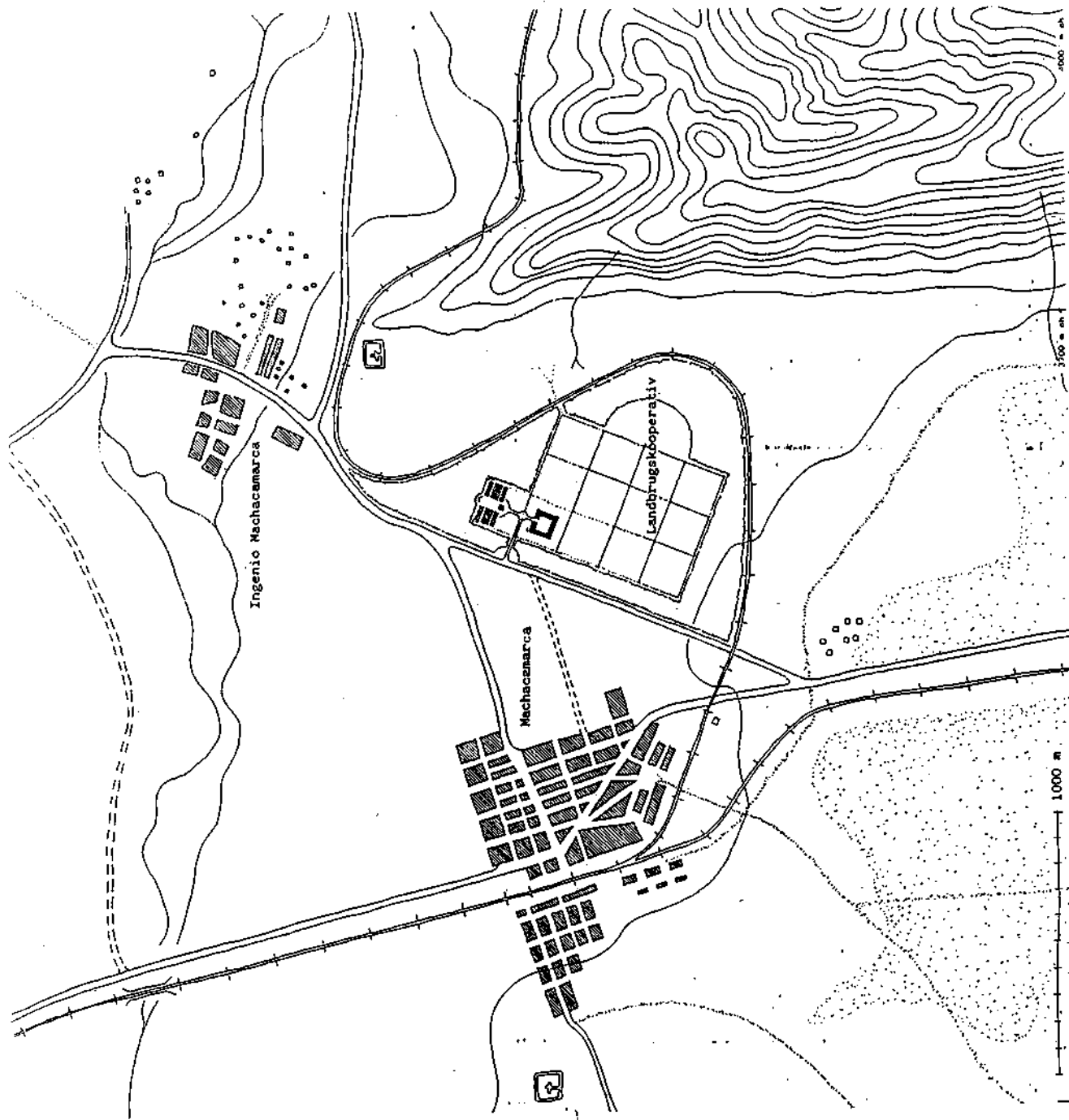


Table of contents

Page 2	siteplan of the village
3	siteplan of the cooperative
4	siteplan showing recidencial area
5	detailed siteplan
6	plan in scale 1:100
7	sections and elevations in scale 1:100
8	sections and elevations in scale 1:100
9	details of constructions
10	details of constructions
11	details of constructions
12	plan types

Siteplan of the Cooperative

The site area is given a squared grid structure often used in south american town planning.

The living area.

The houses are placed close to the Machacomarca main road in order to alleviate the contact with surrounding communities.

The agricultural buildings.

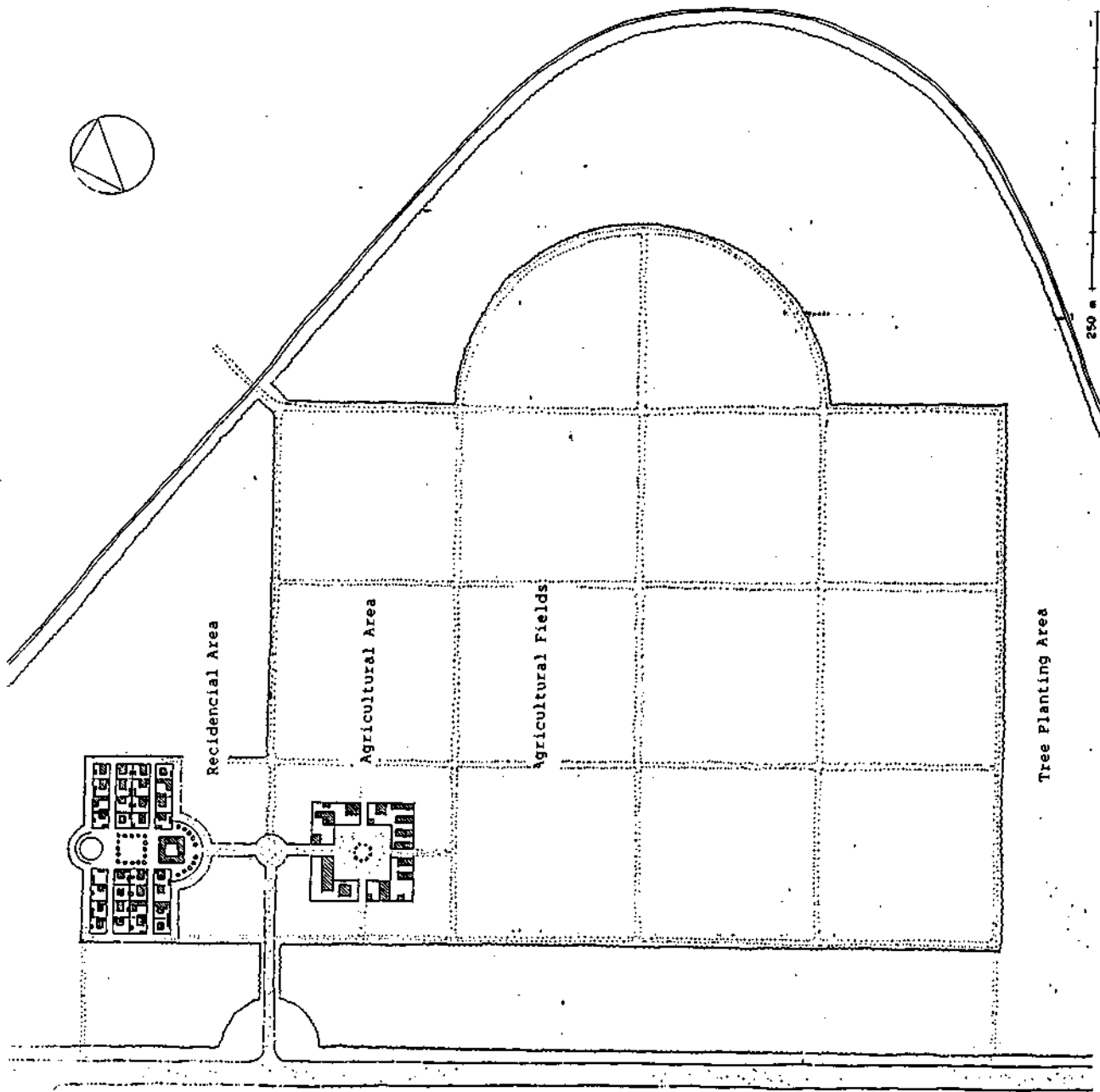
The agricultural buildings are placed south of the recidencial area in such a way, that despite daily trafical annoyances are avoided in the living area, a closeness between the two areas is established.

The agricultural fields.

The way the agricultural field is split up in squares, enhance the possibilities for an efficient use of the land.

Trees.

Trees are plantet in such a way, that they give maximum shelter against the wind in order to avoid soil erosion.



Siteplan of residential area.

32 sites have been established in the residential area. The planning of the area and the architecture of the houses is done in accordance with the local tradition and in cooperation with the members of the cooperative.

Neighbourhood.

The houses are split up in four groups, where it is up to the inhabitants to choose the level of daily togetherness. The four groups of houses are placed symmetrical around common facilities.

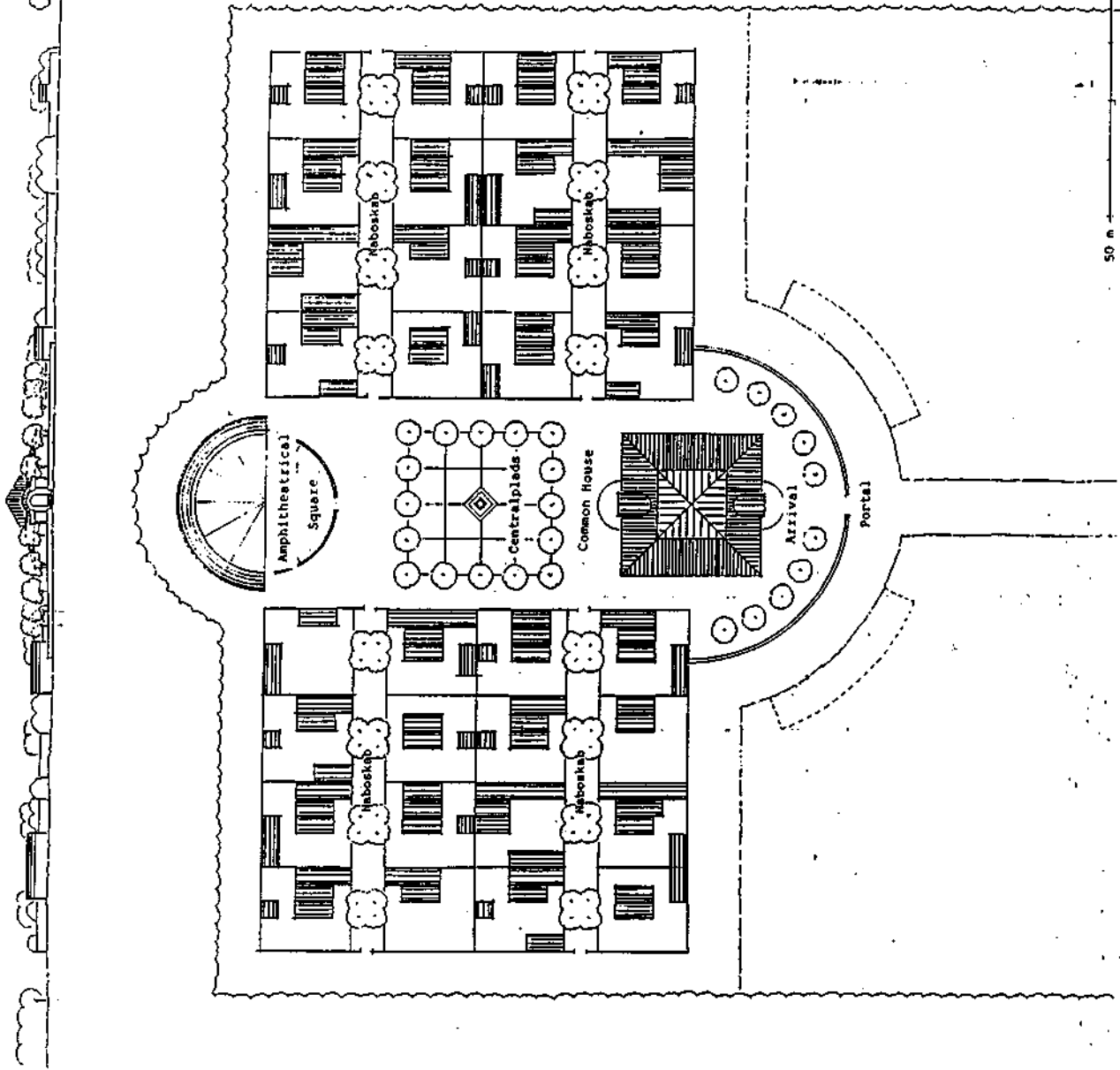
Common facilities.

The amphitheatrical square is intended to be used for larger meetings and festivals.

The central square is intended to be the area where daily informal meetings take place.

The building placed adjacent to the central square will be the place where various sorts of indoor activities will take place.

The arrival area will be designed in such a way, that it will be a symbol of dignity and strength.



Siteplan.

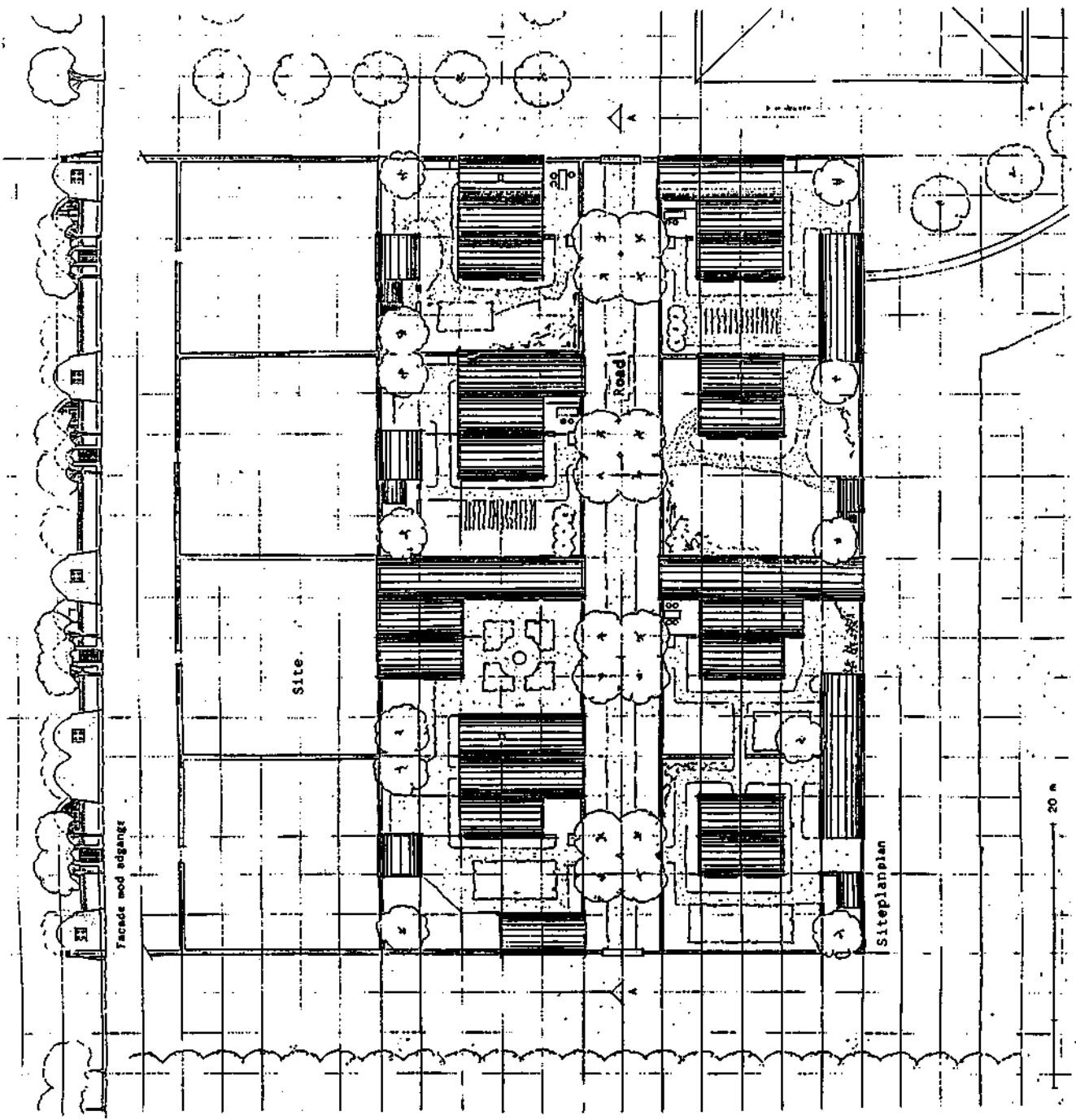
Each group of sites comprises 8 numbers measuring 15 x 15 m. The inhabitant of the cooperative will be given a say about the above as well as all other features within their own area.

Sites.

The sites will be allocated families, who will be given as much freedom as possible to arrange themselves within the site boundaries. A typical family size is 2 adults and 4 children.

Roads.

Feeding roads will be given a width of 6 m. Internal roads will have a width of 3 m with 3 m grass verges.

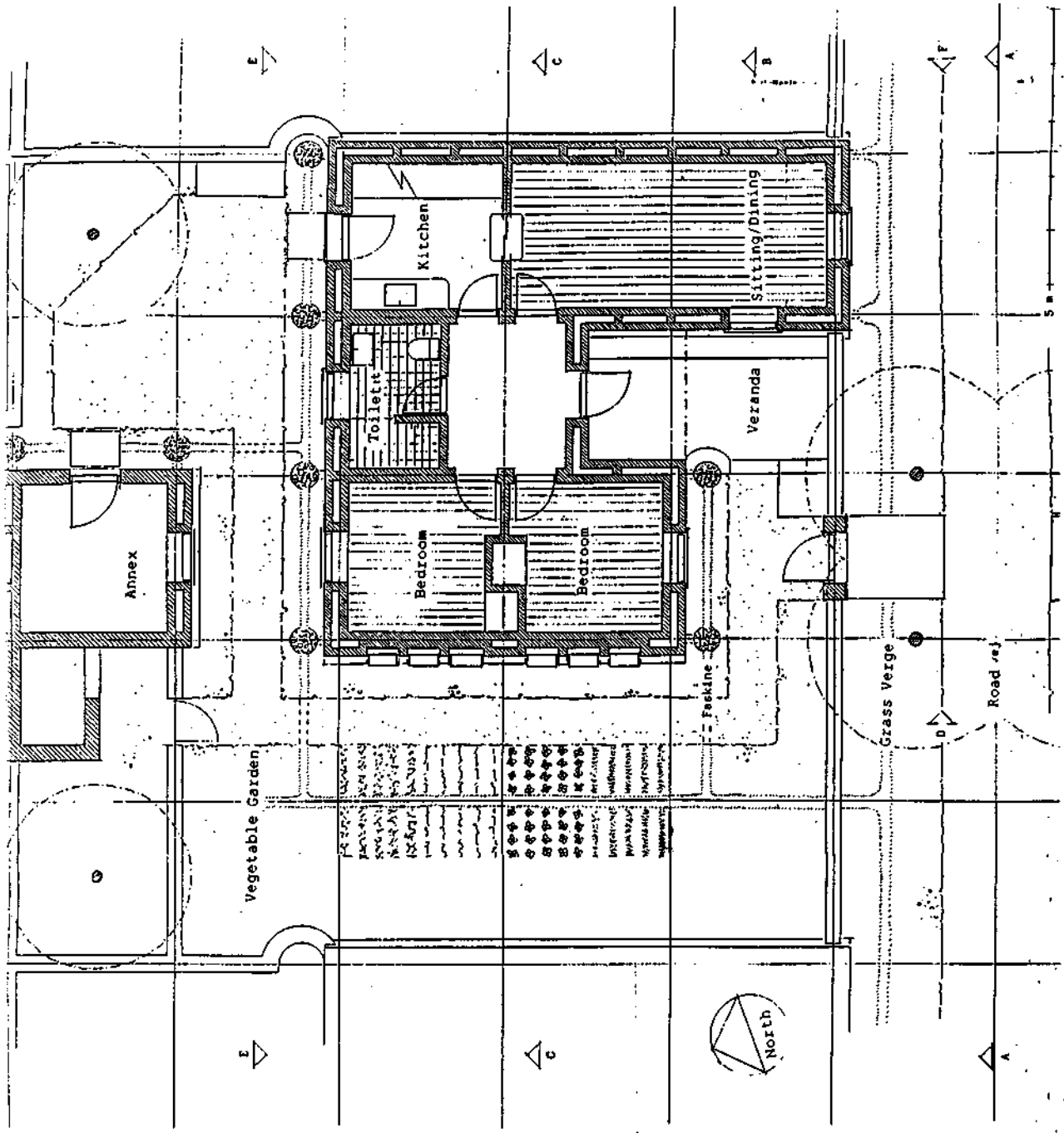


Houses constructed with adobe blocks (unbaked clay blocks).

Earth has been used as building material during centuries all over the world. However, for various reasons earth has during the last century vanished as an "inferior" building material. This has been a logical development in the western world, but created problems in the developing countries, where foreign currency for import of building materials is scarce.

Only few rules have to be taken into consideration in the construction of buildings with adobe blocks. One of the most important is, if the construction is not going to be too complicated, to keep the free spans down to a certain minimum.

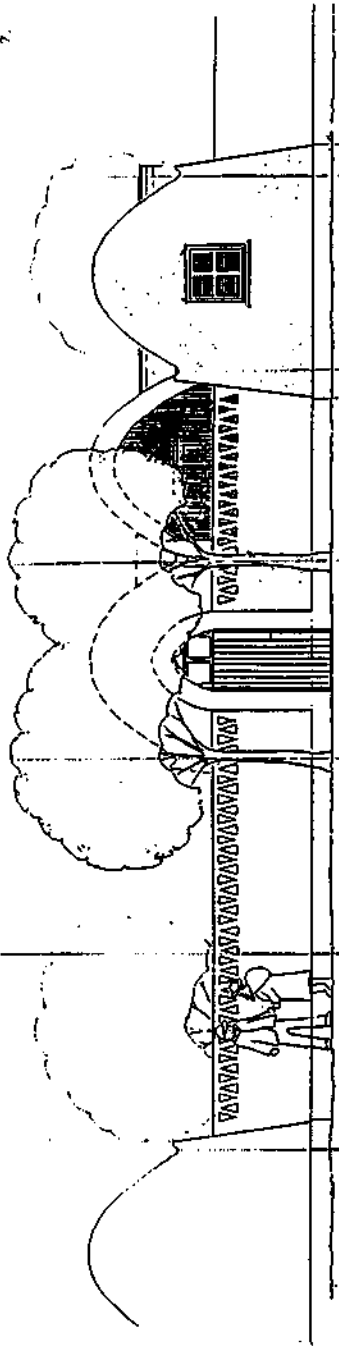
The proposed buildings in this project are to be constructed over a 3 m grid structure, which gives the ideal free span for parabolic shaped roofs built with adobe blocks.



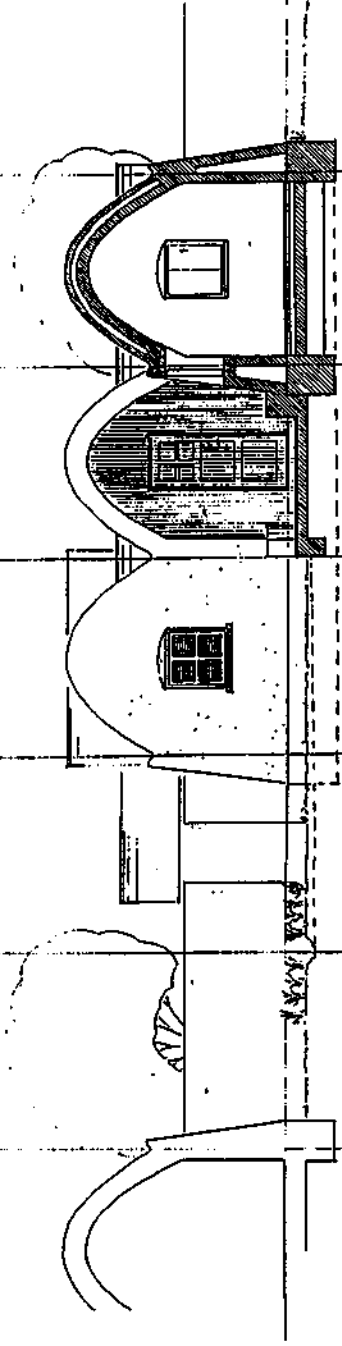
Description of the prototype.

The size of the house is 72 m² comprising a living accommodation and an annex.

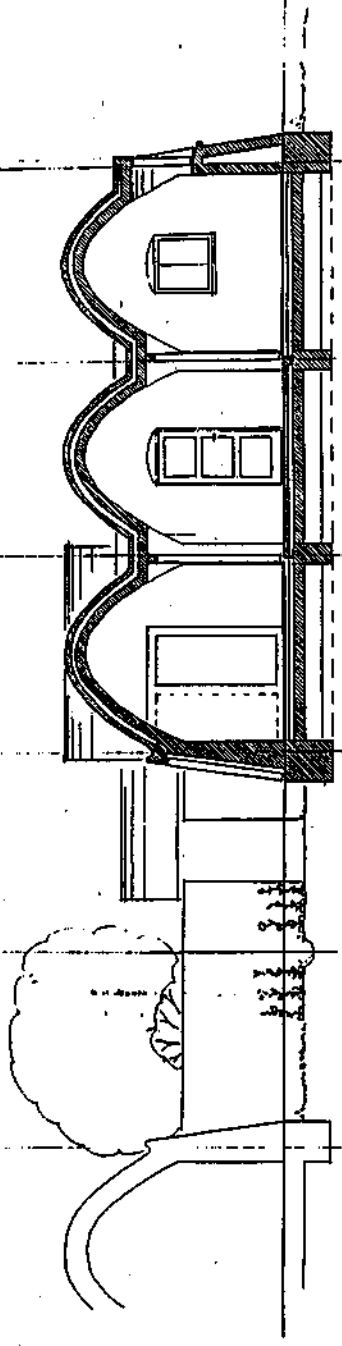
The living accommodation comprises a sitting/dining room, kitchen and two bedrooms.



Elevation A-A



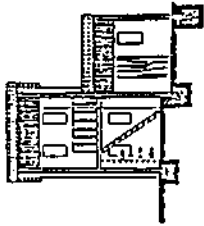
Section B-B



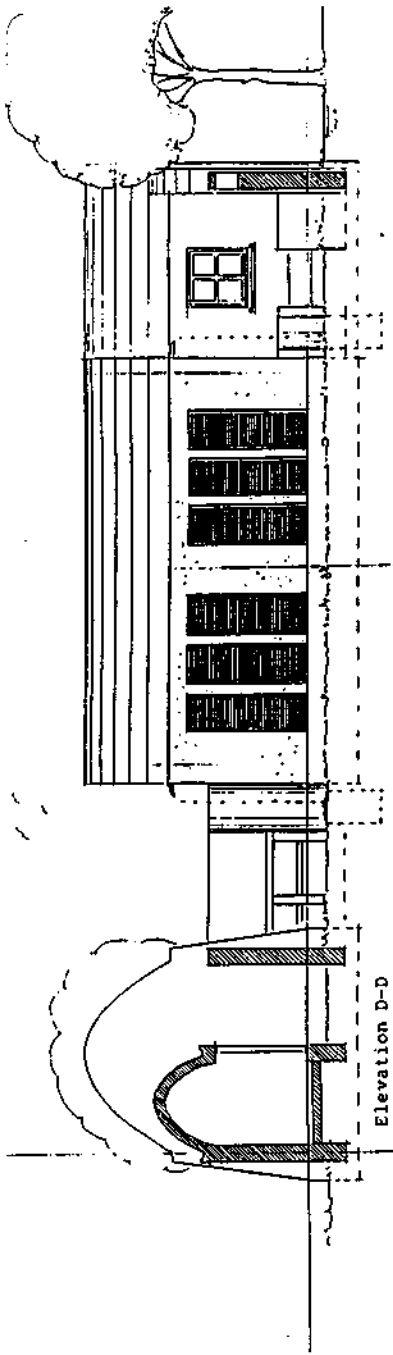
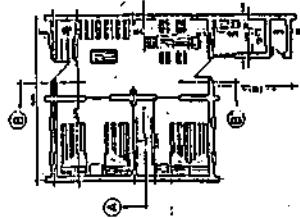
Section C-C

S. Proyecto
 Inca Liojeto
 April 1957

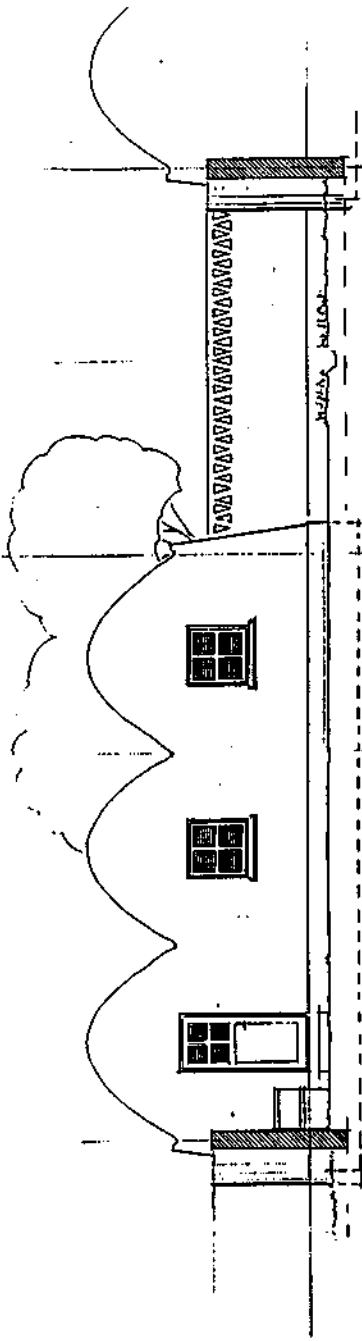
Ministerios de Asuntos
 Urbanos
 Naciones Unidas
 Proyecto SOL/64/001



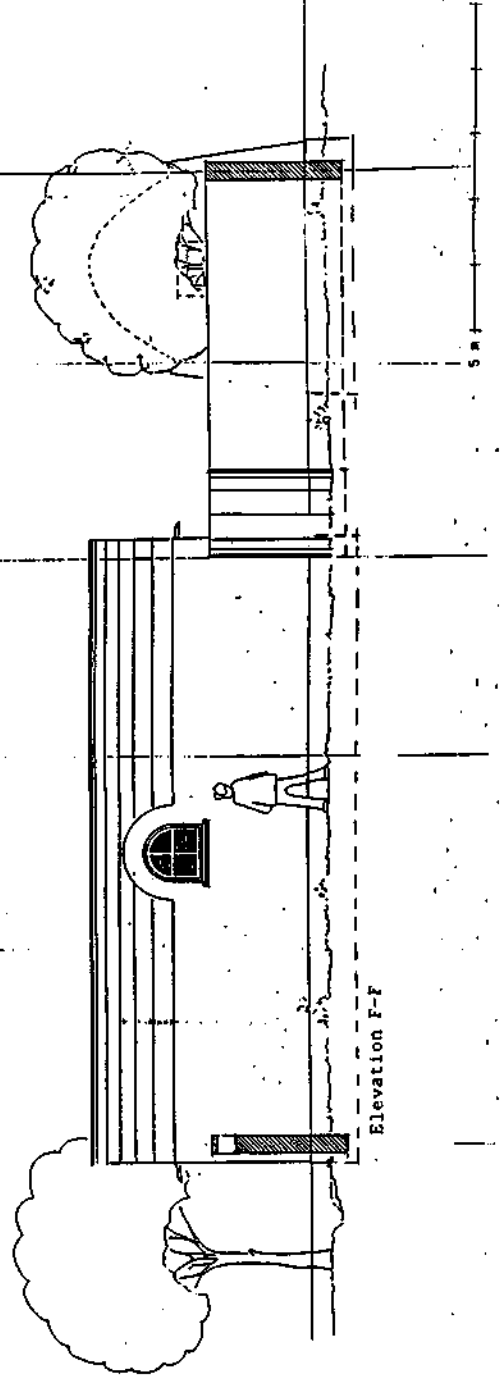
CORTE A-A



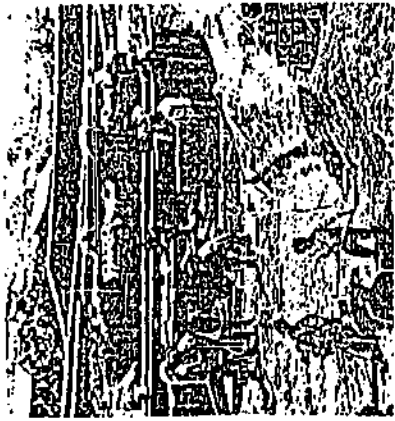
Elevation D-D



Elevation E-E



Elevation F-F



The project has been inspired by various other projects already implemented in Bolivia such as Proyecto Inca Liojeto, La Paz. The project was done by UNCHS HABITAT.

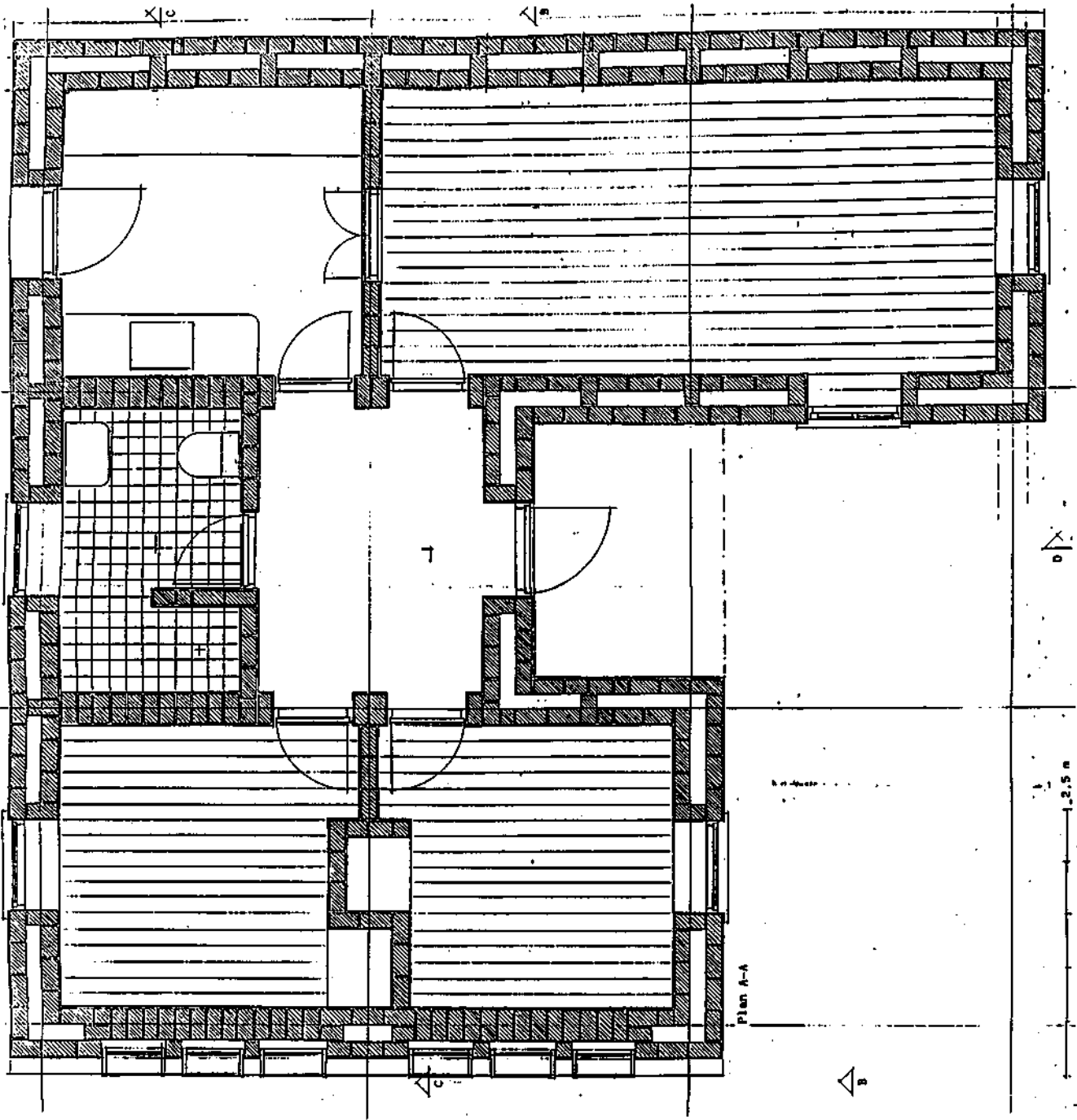
Construction details.

Solar heating.

It is the intention to build trombe walls in order to heat the house with solar energy. A trombe wall is made by transparent sheets placed in front a heavy heat absorbing wall. The heat absorbed in daytime will during the night release the heat to the rooms behind the trombe wall. On the drawing is shown a cheap and simple trombe wall.

Walls.

All walls are erected with 34x 14x 29 cm adobe blocks. Internal walls are plastered with clay mortar. All external as well as internal walls are made by local materials avoiding import of more "normal" building materials.



Roof Construction

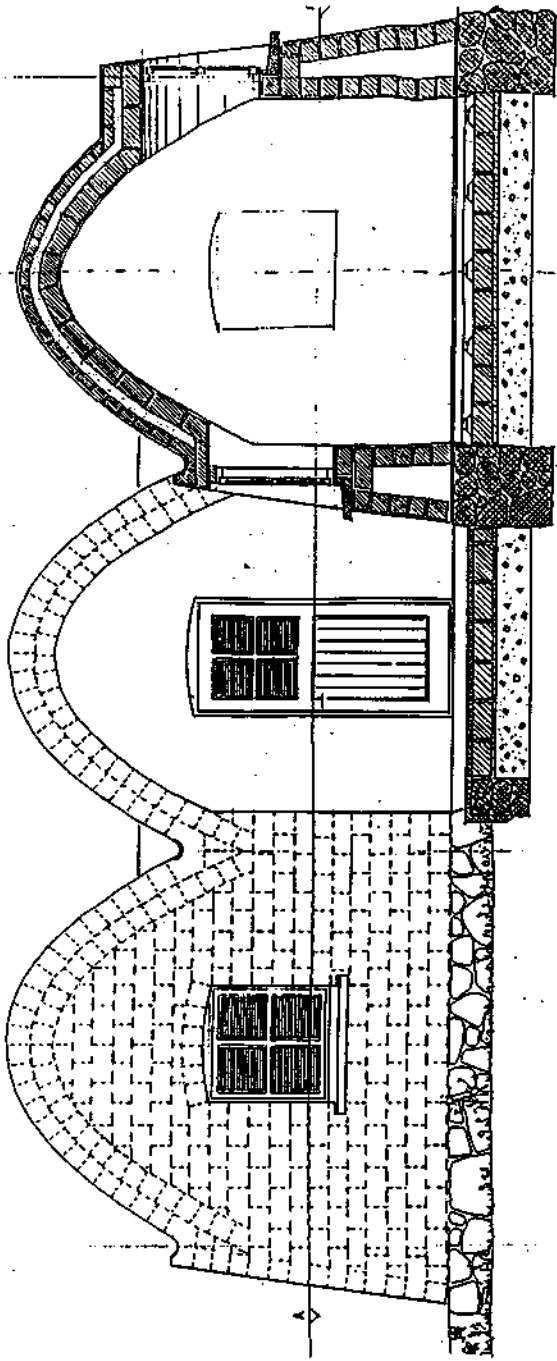
The roof is constructed in parabel shape of 14 x 14 x 29 cm adobe blocks. An outer shell of 6.5 x 14 x 29 cm is built.

The roof will be isolated with granulated clay as shown on the drawing.

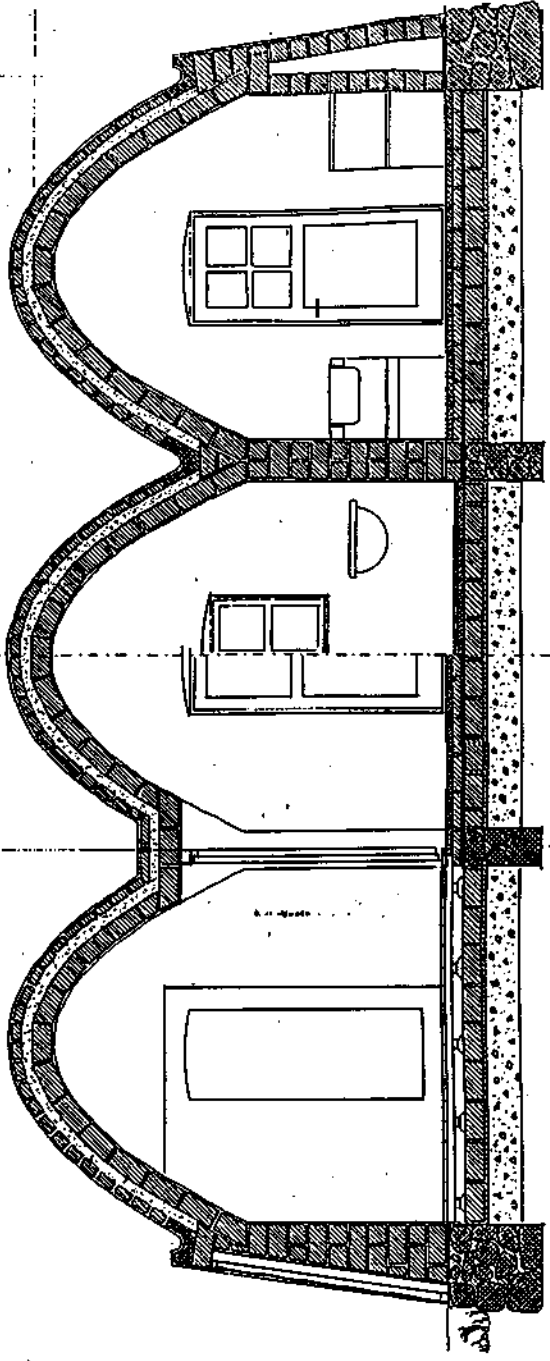
The surface of the blocks is given a rough pattern in order to strengthen the construction.

The roof is supported by the external walls only, avoiding columns and supporting internal walls.

The roof is plastered externally as well as internally with clay mortar. However, the gutters will be strengthened with cement mortar. Further investigations in order to avoid cement in the construction of the gutters have to be carried out.



Section B-B



Section C-C

The above roof construction method avoid importation of building materials such as timber or steel for roof trusses.

Window and doors.

It is the intention to produce windows and doors in local workshops. It is also expected that part of the trombe walls can be produced here.

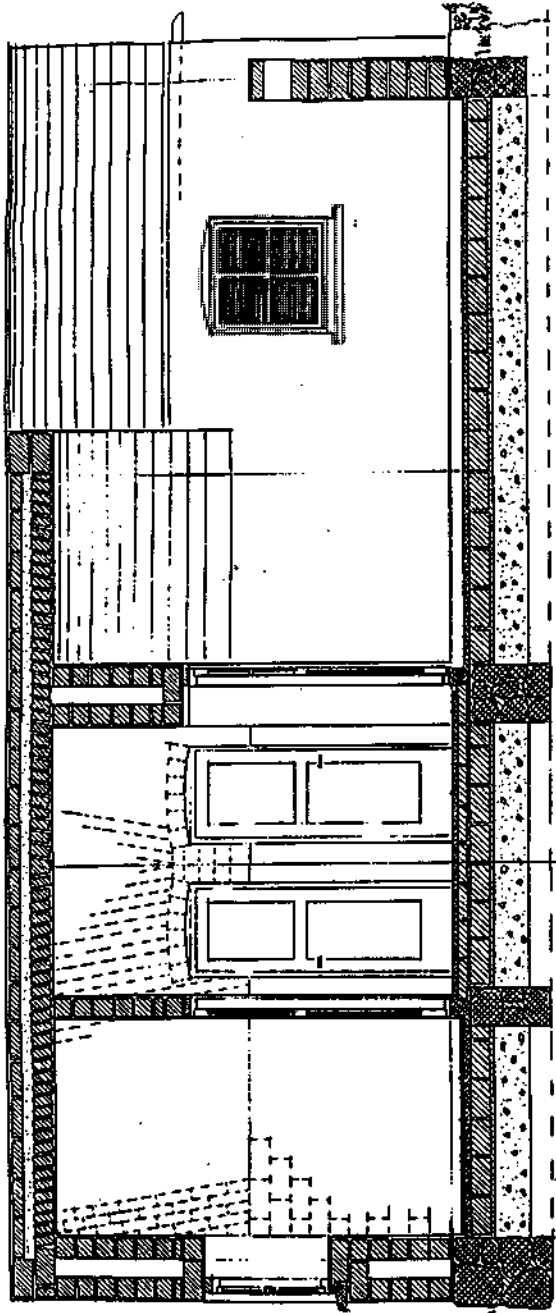
In connection with the planned feasibility study, an investigation of the capability of the local workshops will take place.

Floors.

Floors in kitchen, toilet and on the veranda will be made as concrete slabs. All other floors will be made by burned clay blocks.

Foundation.

Foundation will be built of stones available in the area. Clay mortar strengthened with cement will be used. The top of the foundation will be treated with bitumen.



Section D-D

Plan types

Type A 36 m²

This house could be suitable for a young family without children. The house will in the initial state be without water-, sewage- and electrical installation. A pit-latrine building will therefore be erected, and an oven will be installed in the kitchen. However, the house is designed in such a way that it can grow with the family and that water-, sewage- and electrical installation at a later stage can be applied.

Type B 54 m²

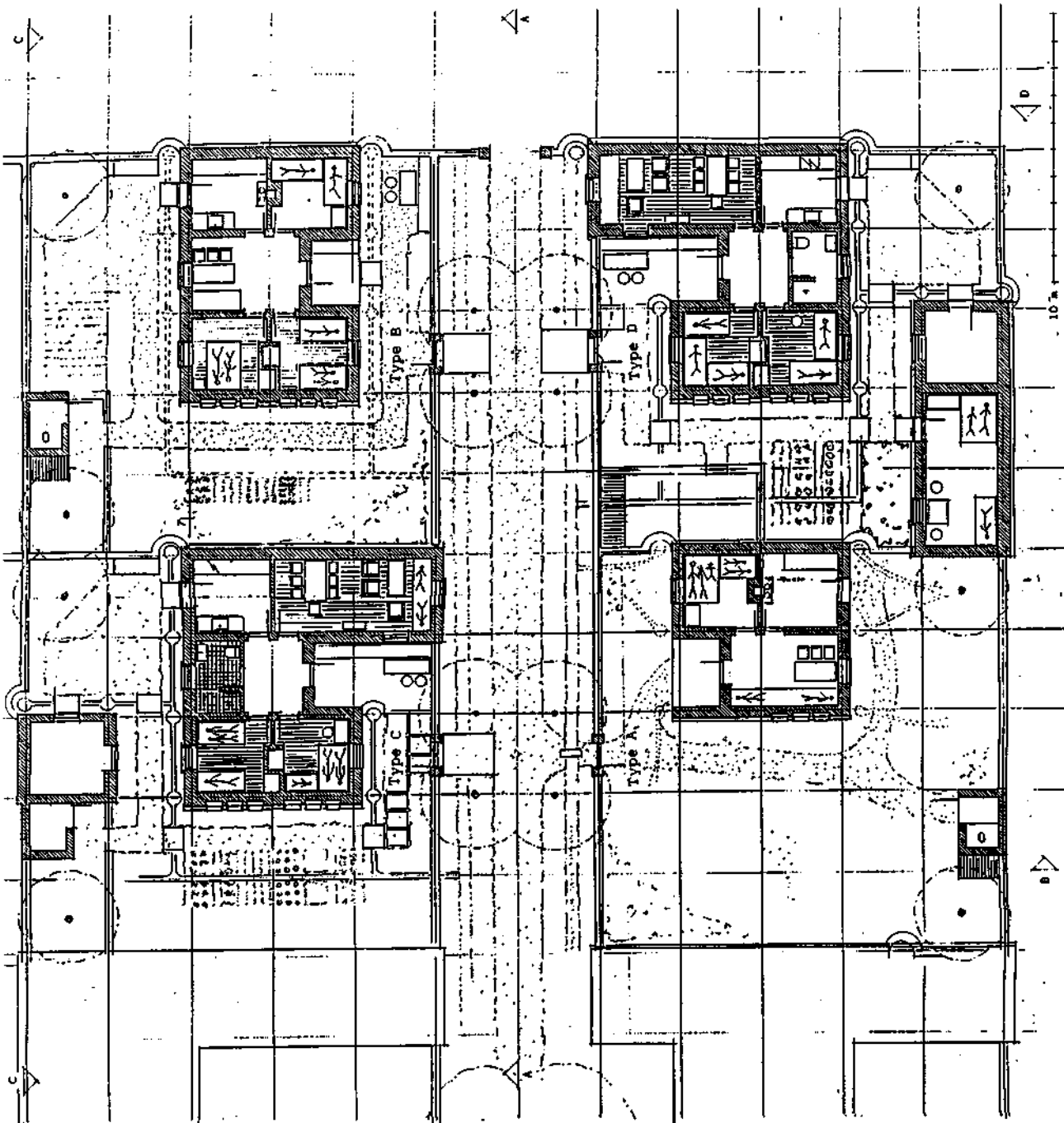
This house is a moderate extension of type A with water installation.

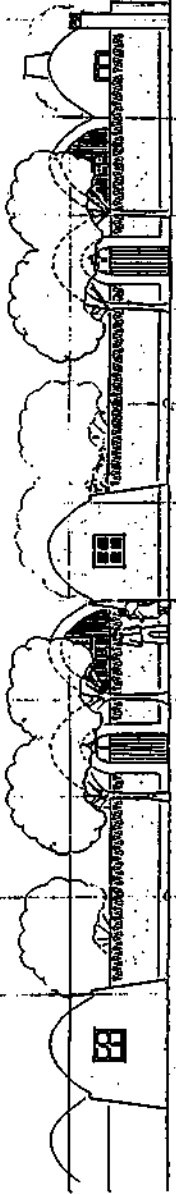
Type C 72 m²

The type is a further development of the previous types and water-, sewage and electrical installations have been applied. The type could be suitable home for a family with 4 children.

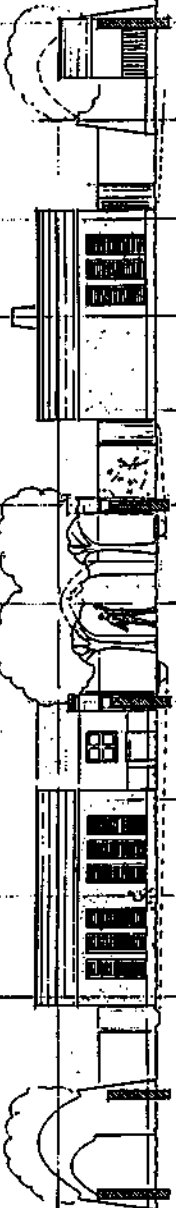
Type D 90 m²

An extended house with annex suitable for a grand parents, parents and 4 children.

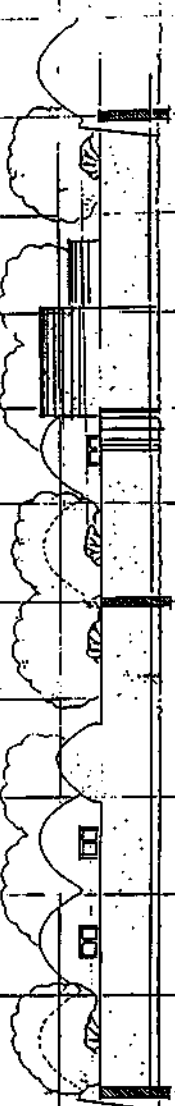




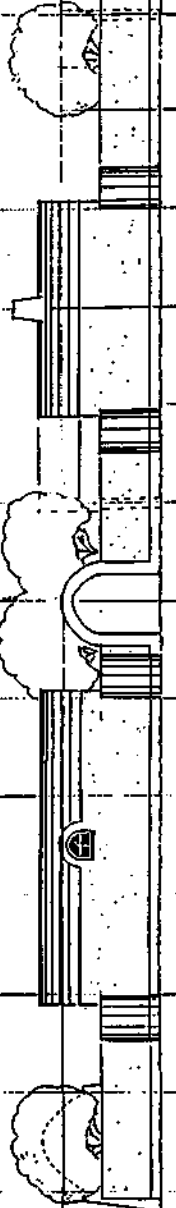
Elevation A-A



Elevation B-B



Elevation C-C



Elevation D-D

DANSK INTERNATIONAL BOSÆTNINGSSERVICE

Danish International Human Settlement Service

Service Danois International Pour L'habitat

Servicio Danes Internacional de Asentamiento Humanos

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