miscellaneous construction - 4 publications, 400 pages

Low−cost Housing − Technical Manual

Table of Contents

Low–cost Housing – Technical Manual

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Prologue

The Low–cost Housing Project is established, based on a bilateral agreement between the Federal Democratic Republic of Ethiopia and the Federal Republic of Germany. It is implemented by the Ethiopian Ministry of Federal Affairs with the support of GTZ (German Technical Co–operation).

After a first phase (2/1999 – 1/2002) the Project has entered into a second phase which ends in July, 2006.

Project's Objective

The objective of the Project is to enable low–income urban dwellers – with special attention to female–headed households – to acquire homes of their own in order to improve their living conditions.

Financially viable and technically sound replicable housing solutions are elaborated at federal, regional and municipal level to be implemented thereafter.

The diversification of the construction sector is a key factor for a sustainable dissemination of cost–efficient building technologies.

The promotion of the construction sector is initiated through Public Private Partnerships (PPP) between German and Ethiopian private sector organizations, facilitated by the German and Ethiopian public sector.

The Rationale

85% of the urban population of Ethiopia lives in inhuman, unhygienic and confined conditions.

Their housing situation lacks infrastructure and is dominated by "chicka" type of construction (traditional construction method with mud and wood).

The population growth of 2.8 % per year and the accelerated migration to urban centres (6 % and more per year) have dramatically increased the demand for affordable, decent housing.

The competitiveness of the construction sector is low because of its low quality and relatively high prices. The reasons are:

- The construction sector lacks skilled construction workers

- The construction sites lack efficient management

- High costs of construction due to wastage of building material of about 30% on construction sites

- Absence of a Federal and Regional Building Laws and a Federal Urban Planning Law

- Limited knowledge about cost−efficient technologies

- The construction industry is not diversified, no specialization in regard to building material suppliers, etc.

- Limited private sector initiative and organizational strength.

Organisational Structure

While the Ministry of Federal Affairs is the Owner of the Project, the Partners on regional and local level are National Regional States, Regional Bureaus of Works and Urban Development, Regional Construction and Design Authorities, Urban Development Offices and Municipalities such as:

- The Municipality of Adama
- The Addis Ababa City Government
- The Bahir Dar Municipality
- The Dire Dawa Administration
- The Regional Government of Gambella
- The Municipality of Jijiga
- The National Regional State of Tigray.

The demands for the services of the Lowcost Housing Project are increasing daily. The nine Regions as well as Addis Ababa and Dire Dawa have called for intervention to support their housing programs offering serviced plots (infrastructure provision) free of lease.

Skills improvement, employment & income generation

The labourers working on the construction sites are introduced to new technologies, receiving systematic training − on − the − job. This helps them in selling their labour force later on, at a higher price as well as multiplying the technology in their respective location. The construction sites, having 100 − 200 labourers each, contribute to employment generation and increase the purchasing power of the labourers involved, consequently boosting the local economy.

Beneficiaries

The beneficiaries are within an income range of roughly Birr 300 and Birr 1300 gross monthly family household income.

They must have a fixed employment as civil servants or within the private sector if they intend to be eligible for a credit through the formal banking system.

Self–payers are also highly welcome if they can deposit 50% of the construction costs before entering into a contract with the Project.

The income range of beneficiaries intends to promote economically and socially mixed settlements avoiding segregation and promoting social stability and economic development.

Introduction

Cost–efficiency is one of the most crucial points of low–cost housing. It can mainly be achieved by standardisation of building elements and reducing the number of different items needed. Pre–fabrication and the use of machines and special tools to produce these standardized elements maximize productivity, resulting in lower costs per unit.

Through intelligent dual–usage of building elements as building parts and as formwork the construction costs are reduced. In the construction process, the amount of wasted materials for formwork can be reduced as well the time for building and dismantling formwork. Re–usage of metal formwork, which can be adapted to every kind of house, helps to economise on the construction costs.

This has also a strong positive effect on the environment.

By planning the work flow accurately, for example the curing time of concrete construction, the productivity can be raised and the quality secured.

The manual describes a modular building system introduced by the Low–Cost Housing Project. In a first part machines and special tools for the pre–fabrication process and simple handycraft–techniques are described. In part two the modular system is introduced: its measurement basics and the standardized building parts are described. The third part visualizes a typical building process on the basis of a model to illustrate the order in which the building parts have to be assembled. A built sample is shown in the fourth part together with pictures from the construction site.

This manual is mainly meant to be a guideline for architects, engineers, construction contractors and their staff such as site supervisors and foremen.

It is not meant to be a substitute for a structural design made by a professional structural engineer. All dimensions presented in this manual are based on experience and calculations made with regard to recent projects. Nevertheless structural calculation has to be done for every project separately.

Technological Concept

Housing designs and urban development considerations

The housing design considers land as scarce commodity and the provision of basic infrastructure as relevant cost factor. The design therefore emphasises densification, small plot sizes and vertical growth. In Addis Ababa, for example, row houses with a five–meter street front on plots of 87.5 sqm allow strong densification doubling the existing plot numbers. The row houses have separate walls in order to avoid noise problems.

The designs are based on the principle of "growing houses", growing according to the financial capabilities and varying needs of the beneficiaries. Low income dwellers will go for the cheaper solution of only ground floor housing, others will go for the more expensive solution of G+1. However, those having selected the ground unit have the chance to expand their house to G+1 once their financial capabilities have increased. This can be done by lifting the roof (EGA sheets), constructing the walls for G+1 and putting the same roof on top. In this manner, the houses can be easily adapted to the increasing needs for dwelling space of a growing family according to their financial possibilities.

In future, apartment houses (up to G+4) will be constructed in order to economize more on the costs for basic infrastructure and reduce the sqm price for construction.

However, the costs for basic infrastructure can only be economized if inbound infill areas are used. Settlements on the fringe or outside of urban centres are financially not viable because of the high costs for the provision of minimum basic infrastructure.

Introduction of new technologies

The housing designs are elaborated according to the Ethiopian Building Code Standart and take into consideration the different earthquake zones within Ethiopia.

The following new technologies are introduced by the Low–cost Housing Project:

- New hollow block size – more economical, easier to handle.
- U–shaped block, same size as hollow block used for prefabrication of lintels and beams.
- Reinforcement for columns inside of the hollow blocks – no formwork required for columns.
- Combined strip– and slab foundation – apt for any kind of soil.
- Pre – fabricated slab system (beams and hollow blocks) – no formwork required.
- Modular architectural system – adjusted to varying financial capabilities of beneficiaries.
- Designs to be adapted to any kind of soil and earthquake regions.
- Reduction of material wastage of up to 30%.
- Environmentally friendly approach, as no wood is needed for formwork.

Cost – efficiency considerations

The construction costs obtained so far vary between Birr 500 and Birr 800 per sqm, depending on the soil conditions, availability of building materials, earthquake zone and housing type. They include the direct and the overhead costs of the construction site. The costs for basic infrastructure are not included, as they are being covered by the Municipality and in certain cases partially by the beneficiaries. The costs for sanitary and electrical installation as well as for sealed, collective septic tanks with soak away pits are included in the sqm price.

The project has hence achieved a cost reduction of up to 40% in comparison to the current construction costs per sqm in Ethiopia.

Environmental considerations

The positive environmental impact consists of a reduced consumption of wood as no wooden formworks are used. By placing reinforcement directly into different types of hollow blocks or u–shaped blocks or by using reusable metal formwork or pre−cast elements, wood consumption is extremely minimized.

By introducing a modular architectural system the number of different building parts is reduced, leading to a further reduction of different types of formwork.

Moreover the usage of local materials, whenever cost efficient, has a positive effect on the enviroment, because of less pollution through reduced transport.

Houses also have to be free of major maintance and repair work for 10 years and the life span is considered to be at least 50 years, reducing the negative impact on the environment and the national economy, that would otherwise arise from the need of rebuilding houses.

In climatically unfriendly areas with high day−temperatures and cold nights or high humidity in combination with high temperatures, the design approach will be adapted to this special climates to avoid extreme room temperatures. The use of air−conditioning can be avoided by appropriate climatically adapted housing designs. Hence the future consumption of electrical power and financial expenses can be reduced.

Appropriate neighbourhood planning is considered essential to create a healthy community. Waste water treatment planned and implemented on the level of the whole settlement reduces costs. It reduces also the pollution of the environment caused by poor maintance of individual septic tanks and soak−away pits. Re−usage of clarified waste water as fertilizer and for irrigation in urban agriculture will be considered in the future to properly use the ecological and economical potential of waste water.

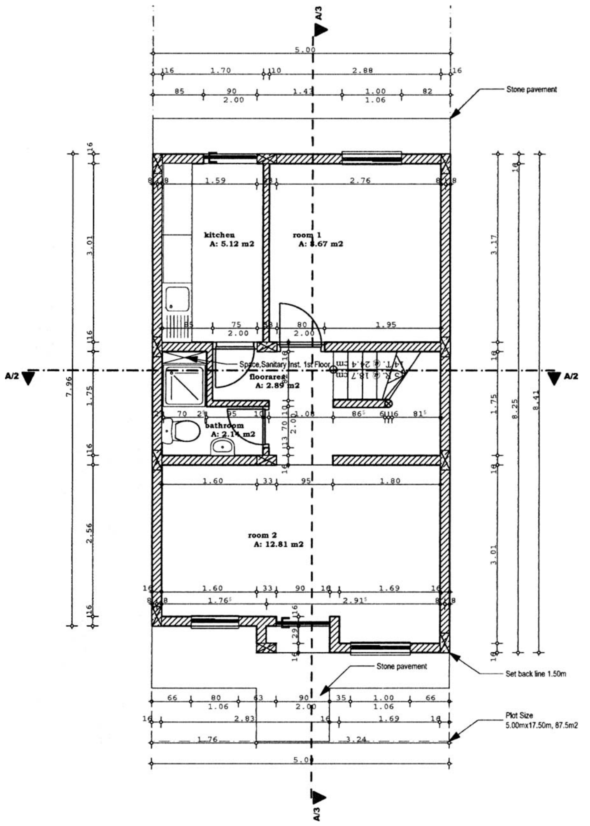
The architectural designs and pictures of the construction process for two of the sites, Addis Ababa and Mekele, are shown in Figures 1−4.

Built Examples

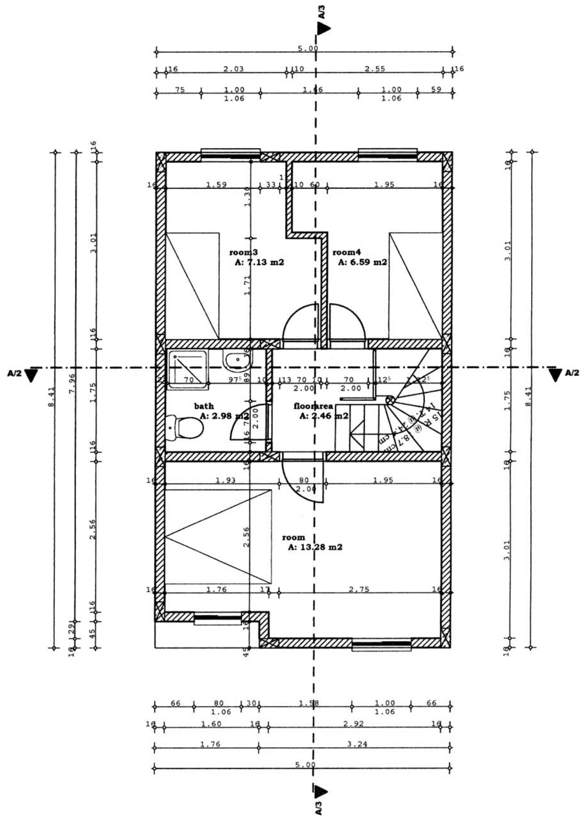
A built example: the Addis housing type

(Row house/Alert Site)

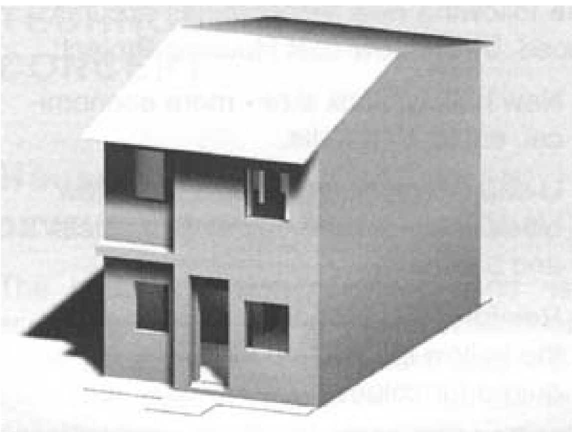
FIG. 1



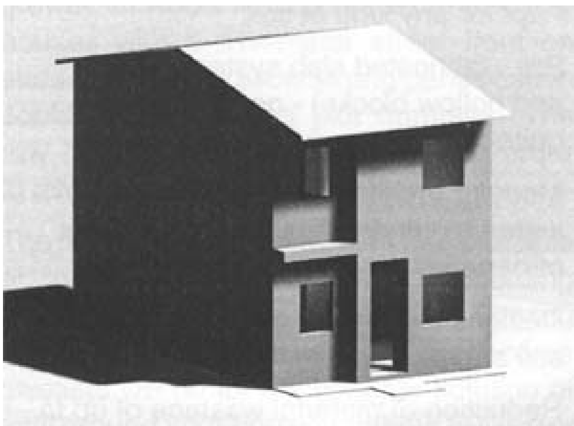
GROUND FLOOR, SCALE 1:100



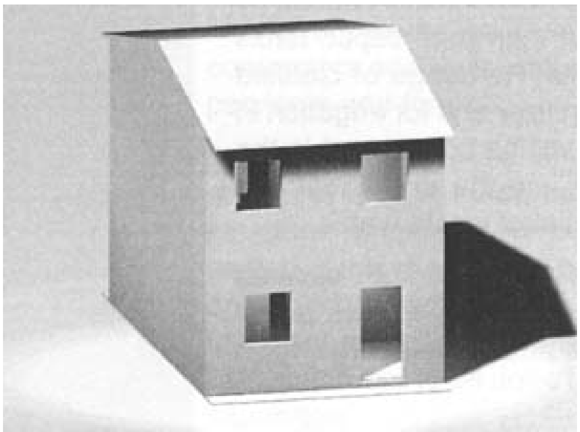
1st FLOOR, SCALE 1:100



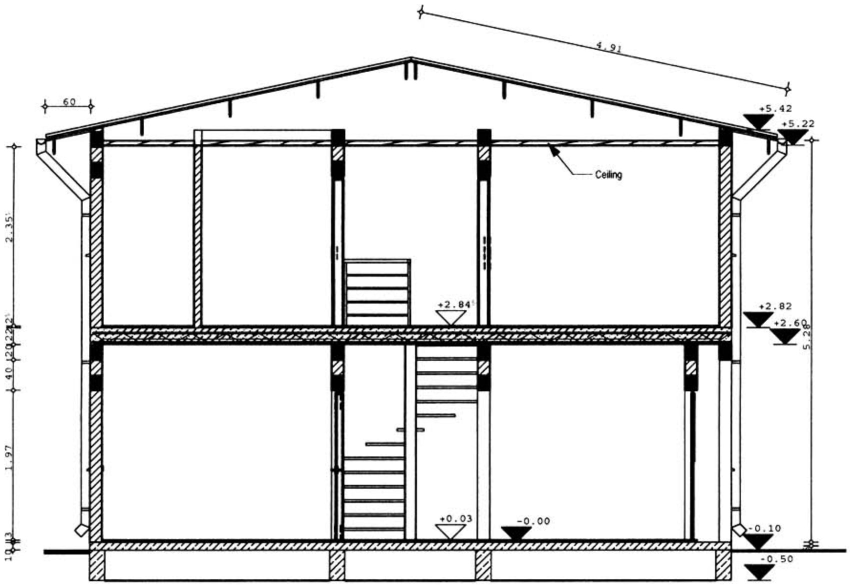
Street side view



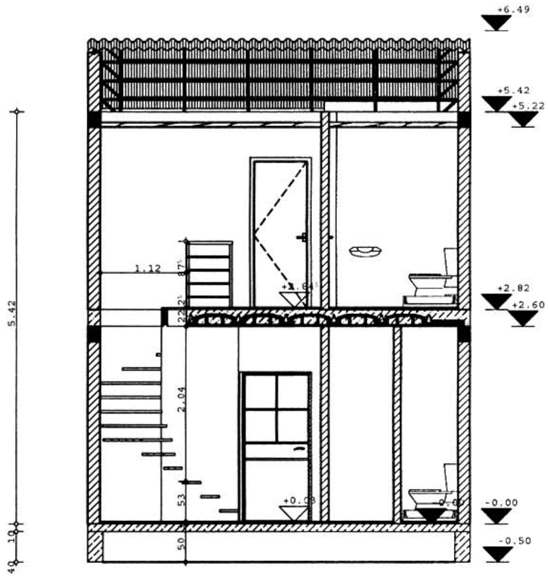
Street side view



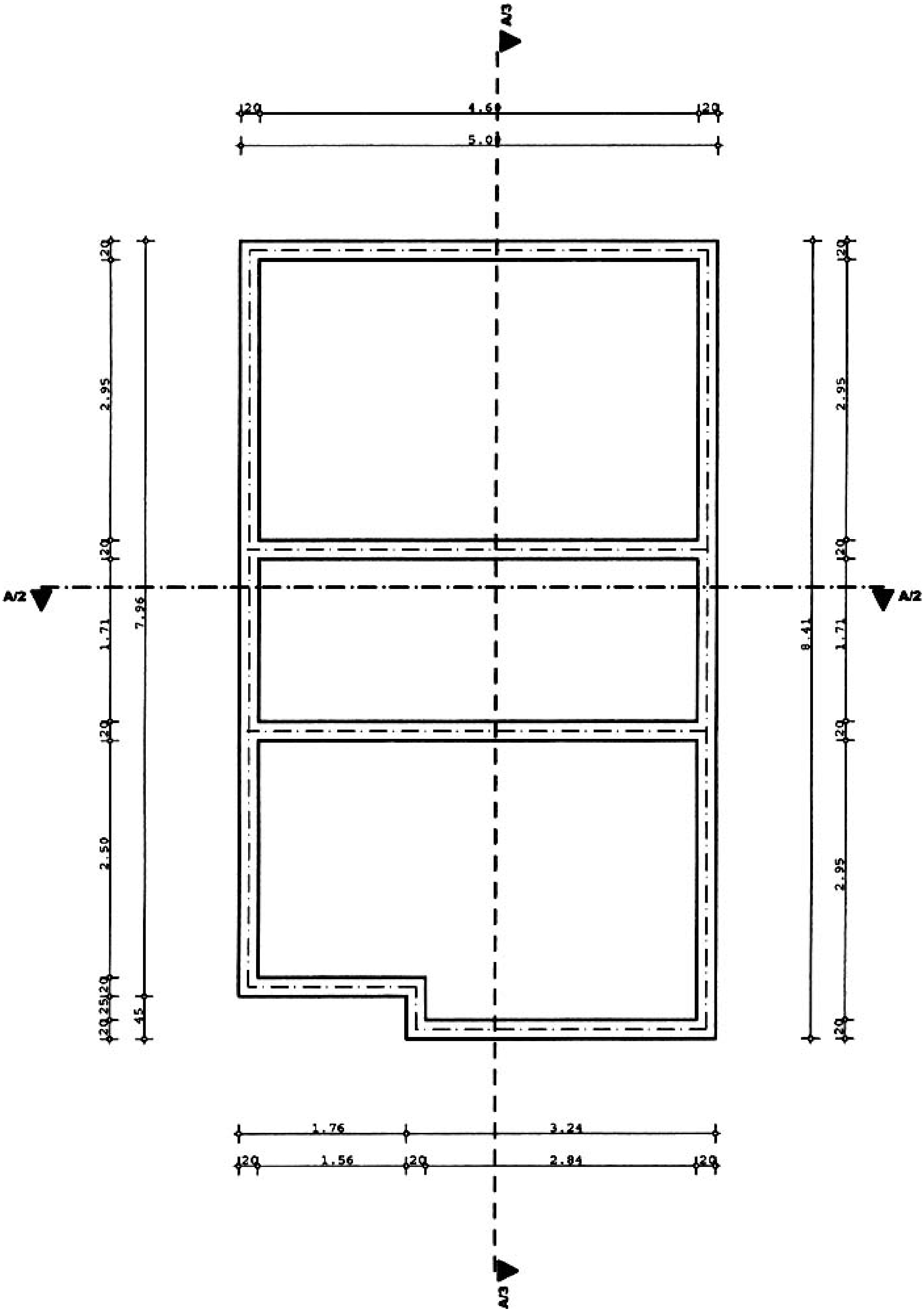
Back yard view



SECTION A/3, SCALE 1: 100



SECTION A/2, SCALE 1: 100



FOUNDATION, SCALE 1:100

Project's data:

- Row–house type, following the contour lines of the terrain to lower costs.
- Gross plot area: 15,251 sqm
- Total no. of units: 178 units
- Plot size per unit: 87,5 sqm
- Built up area per unit: 42,05 sqm

Addis housing type building process

(Alert Site)

FIG. 2
PICTURES FROM CONSTRUCTION PROCESS IN ADDIS ABABA

Levelling for the foundation is made

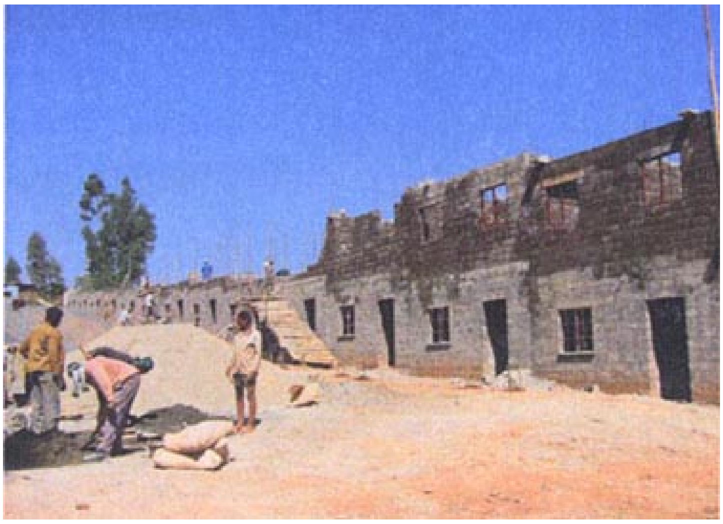
Preparation for combined strip and mat foundation

Construction of foundation using compactor

Sanitary pipes are installed

Ground floor finished, reinforcement for further walling, backyard view

Starting the upper floor, street side view

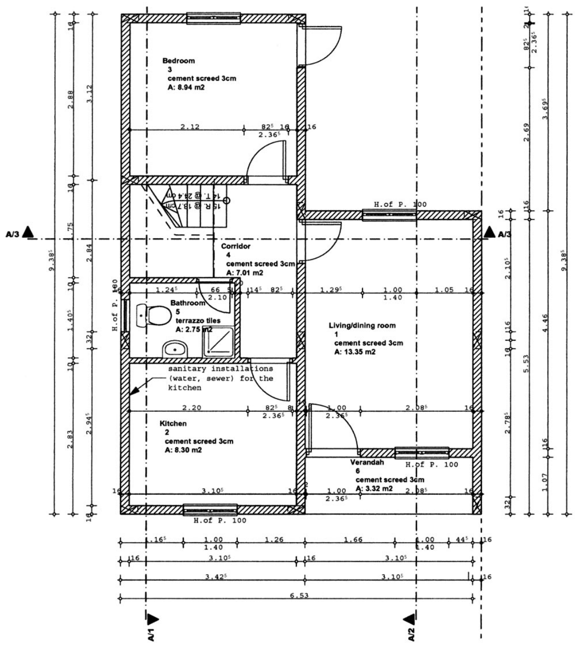


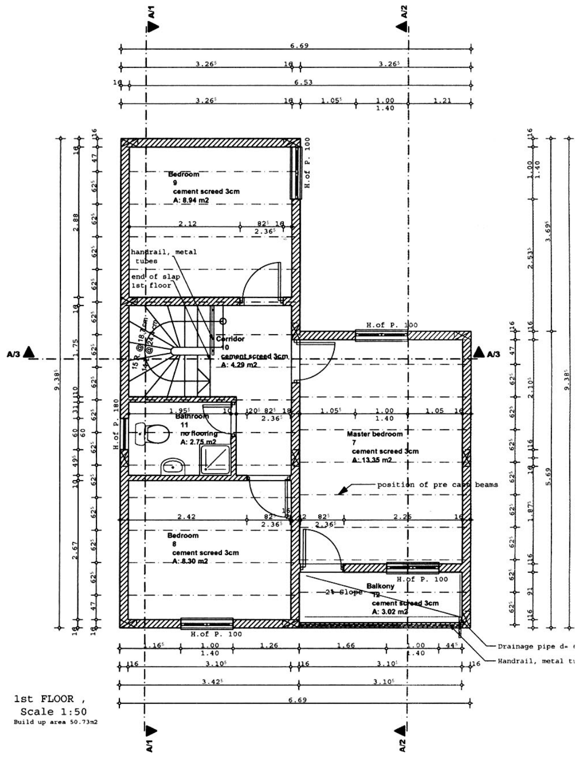
Finishing the walls of the upper floor, street side view

Finishing the upper floor, backyard view

A built example: the Mekelle "A" housing type

FIG. 3





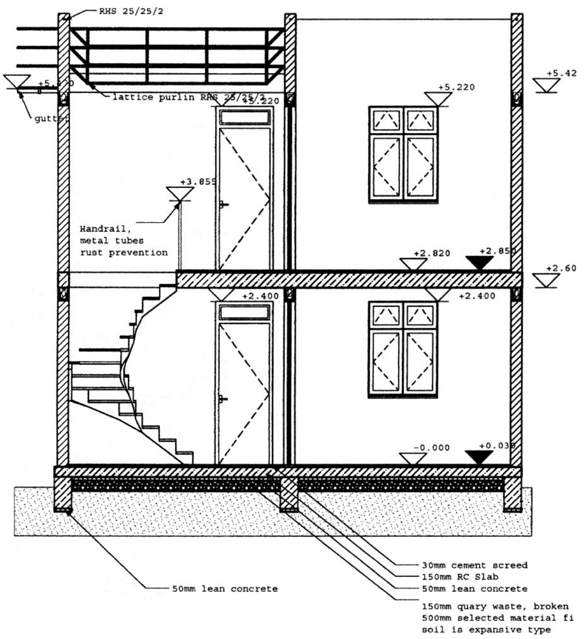
GROUND FLOOR, SCALE 1:100

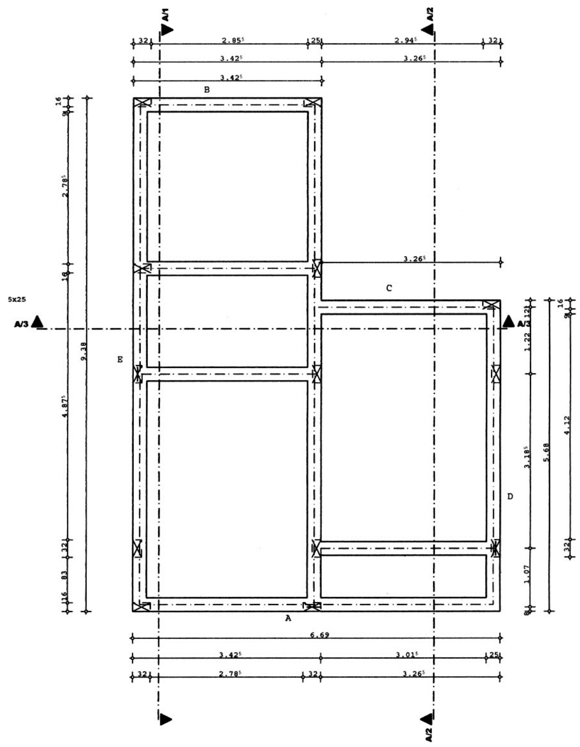
1ST FLOOR, SCALE 1:100

Street side view

backyard view

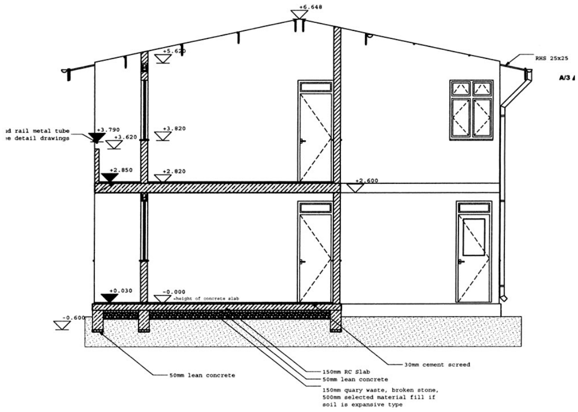
backyard view





SECTION A 2, SCALE 1:100

FOUNDATION, SCALE 1:100



SECTION A 1, SCALE 1:100

Project’s data:

- G+1
- Gross plot area: 0,872 ha
- Total no. of units: 50 units
- Plot size per unit: 170 sqm
- Build up area of 50,73 sqm

Mekelle housing type building process

FIG. 4
PICTURES FROM MEKELLE CONSTRUCTION PROCESS

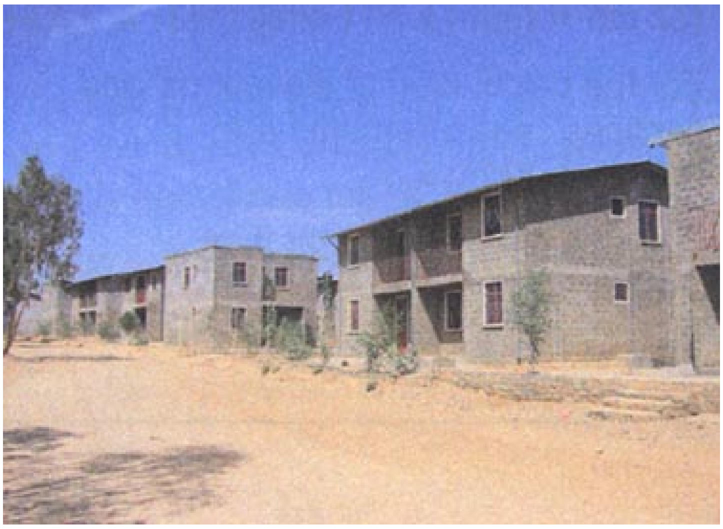
Lost formwork for foundation

The finished foundation


Starting first floor


Starting the roof construction, street side view


Finished building


Street side view


Open spaces between buildings


Buildings are embedded into greenery, planted before

Design Basics

Basic measurements and masonry bond

FIG. 5
MEASUREMENTS

The construction of cost efficient houses requires reducing wastage of material. Reducing wastage depends on using modules which starts from the smaller parts like the masonry blocks and repeats themselves of longer scale of the whole housing unit.

The basic measurement system used in the project depends on a module of 32 × 19 × 16 cm (width × height × depth), being the outer measurements of one hollow block (HCB) unit.

Three types of measurements have to be differentiated (ref. to fig. below) and calculated as follows, considering a mortar joint width of 1 cm.

This system of measurement calculation has also been transferred to elevations and sections to do the height calculations.

– Full size:

Columns measurements have to be equal to the module size plus one mortar joint multiplied by the number of units used (n) minus one mortar joint.

For the calculation of ground floor plans' measurements are:
(32 cm + 1 cm) × n –1 cm

For the calculation of elevations' and sections' measurements are:
(19 cm + 1 cm) × n

– Full size plus one mortar joint:

Submissions length is equal to the unit size plus one mortar joint multiplied with the number units used (n).

For the calculation of ground floor plans' measurements are:
(32 cm + 1 cm) × n

For the calculation of elevations' and sections' measurements are:
(19 cm + 1 cm) × n

– Openings:

Opening size is equal to the module size plus one mortar joint multiplicated with the number of units used (n) plus one additional mortar joint.

In short, for the calculation of ground floor plans' measurements:
(32 cm +1 cm) × n + 1 cm

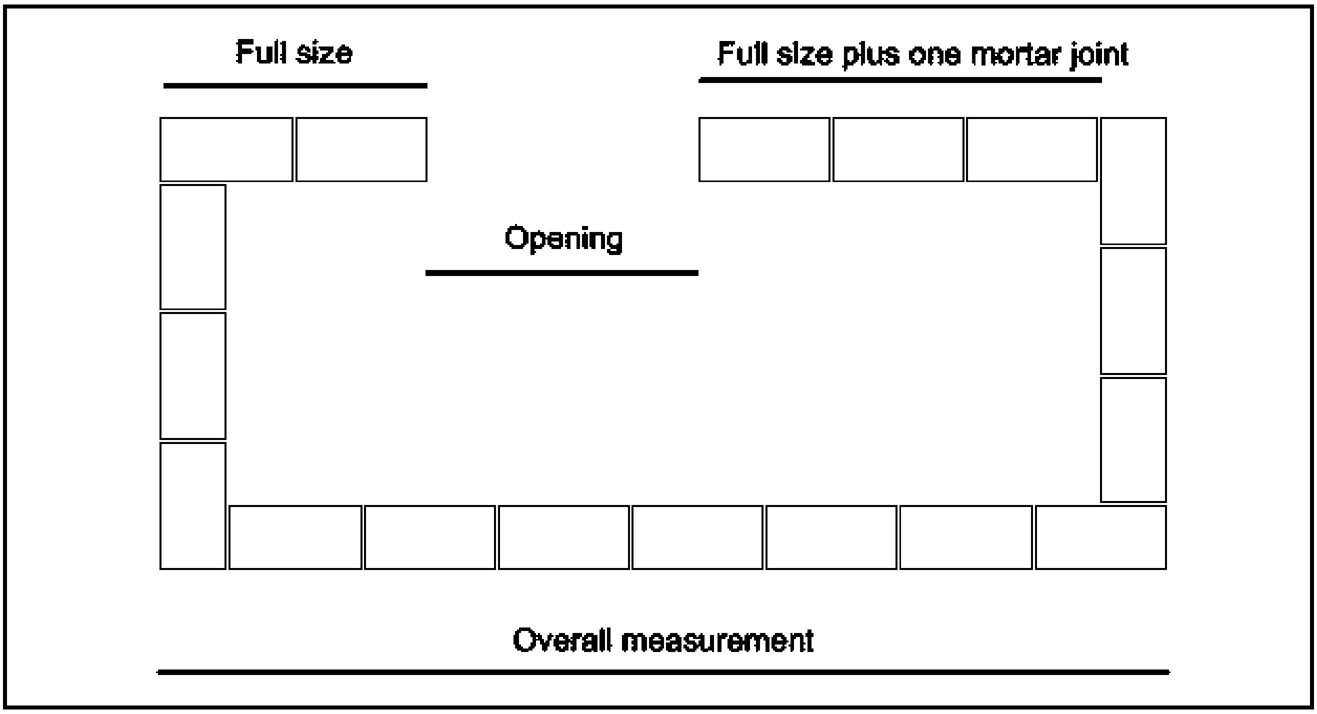
In short, for the calculation of elevations' and sections' measurements:
(19 cm + 1 cm) × n

In addition, one can calculate the outer measurements of masonry–bond building parts as follows:

– Overall measurement equal to the unit size plus one mortar joint multiplicated by the number of units used (n) plus one half module size.

For the calculation of ground floor plans' measurements are:
(32 cm + 1 cm) × n + 16 cm

For the calculation of elevations' and sections' measurements are:
(19 cm + 1 cm) × n

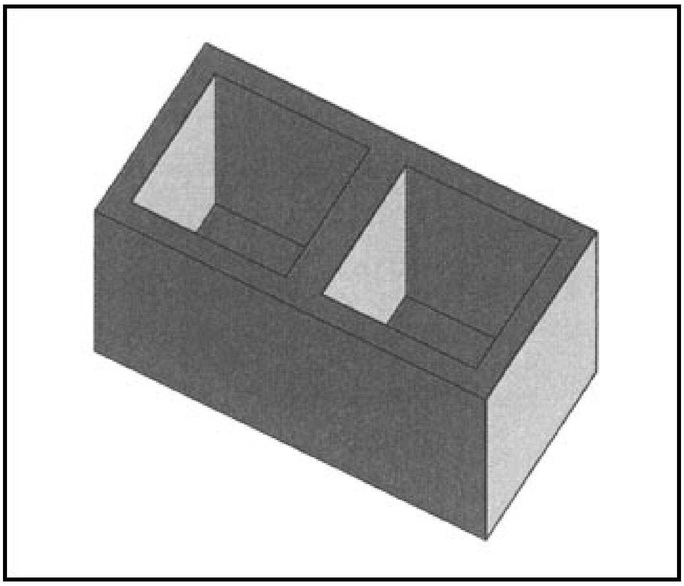


Scheme of different types of measurement for a ground floor plan shown as an example

Building Parts 1

Full HCB

FIG. 6
VIEW OF FULL AND HALF HCB



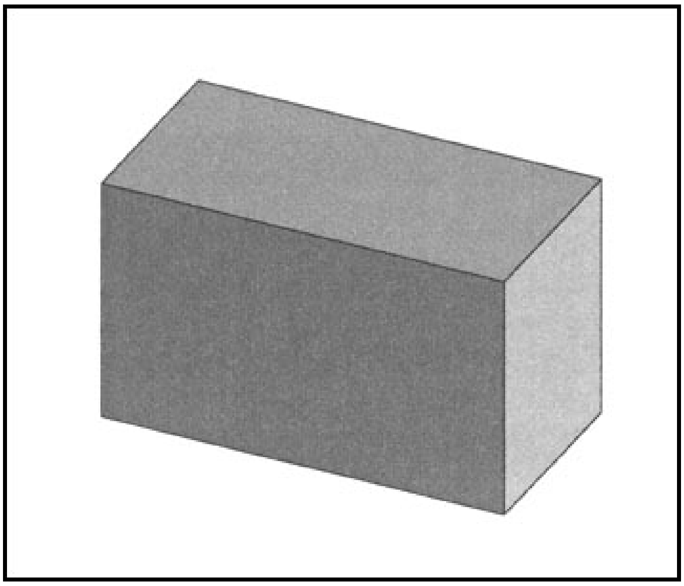
Full hollow block viewed from bottom

The full hollow block has a size of L=32 cm × W=16 cm × H=19 cm. This size of the HCB is reduced in comparison to the usual sizes used in Ethiopia. The new size of the hollow block reduces the production material and makes the HCB easier to handle, this reduces labour and material costs.

During the wall construction the hollow block is placed up with the closed bottom facing upwards. Therefore the loss of mortar during construction is reduced and the bond between HCBs is increased.

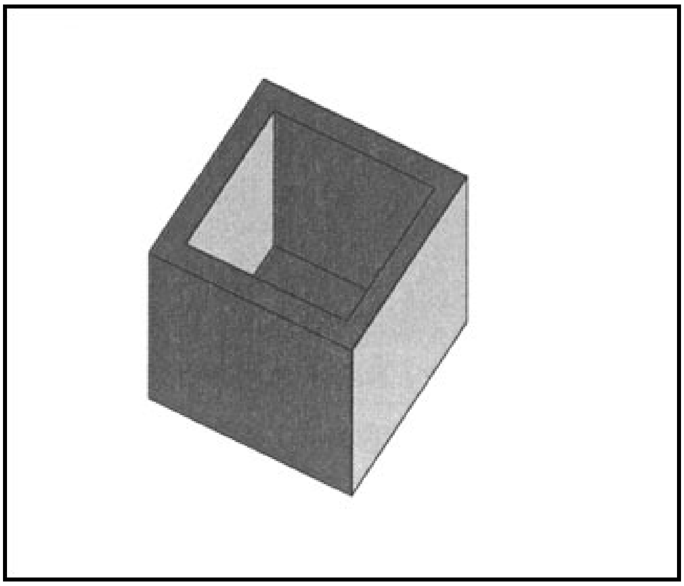
One mason can build 170 pcs of HCB per day on an average.

After wall construction, it has to be watered for at least 7 days.



Full hollow block viewed from top

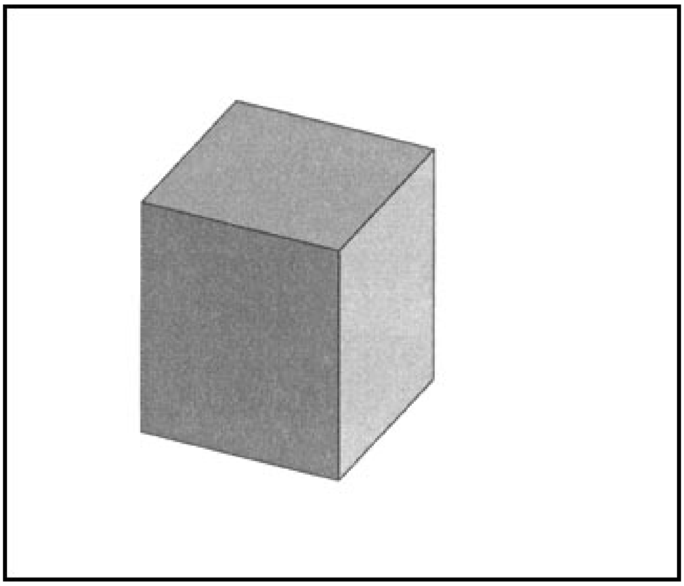
Half HCB



Half hollow block viewed from bottom

The half hollow block has a size of L=16 cm × W=16 cm × H=19 cm and represents exactly half of one full HCB.

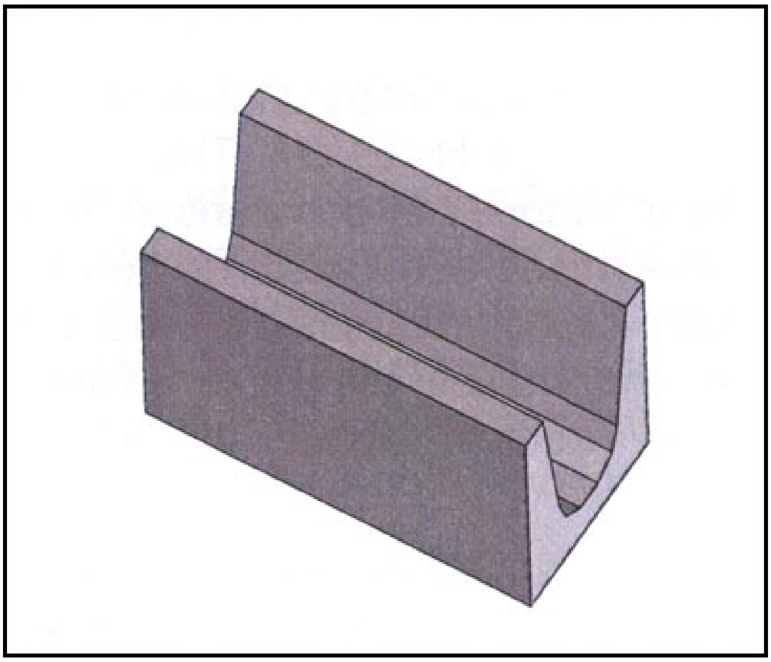
Usage is similar to the full HCB.



Half hollow block viewed from top

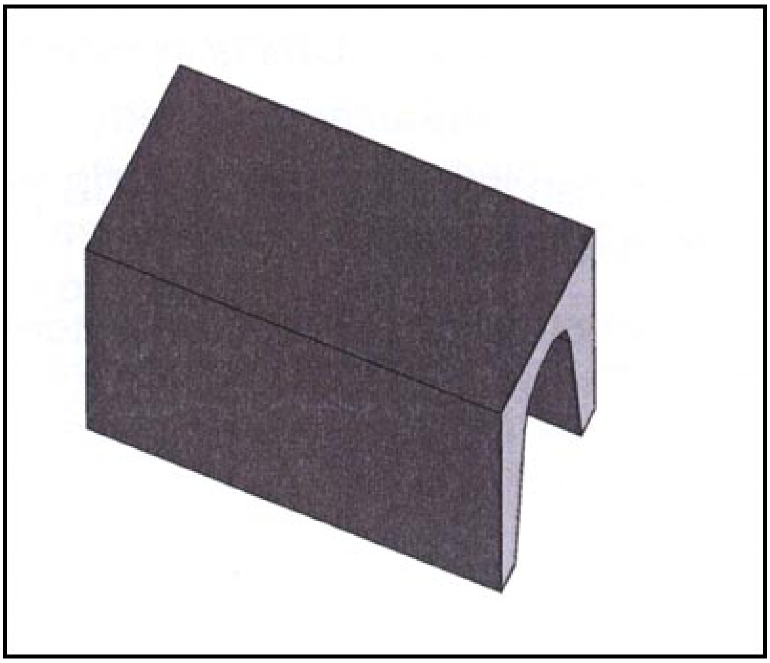
U–Shaped HCB

FIG. 7
VIEW OF U–SHAPED HCB



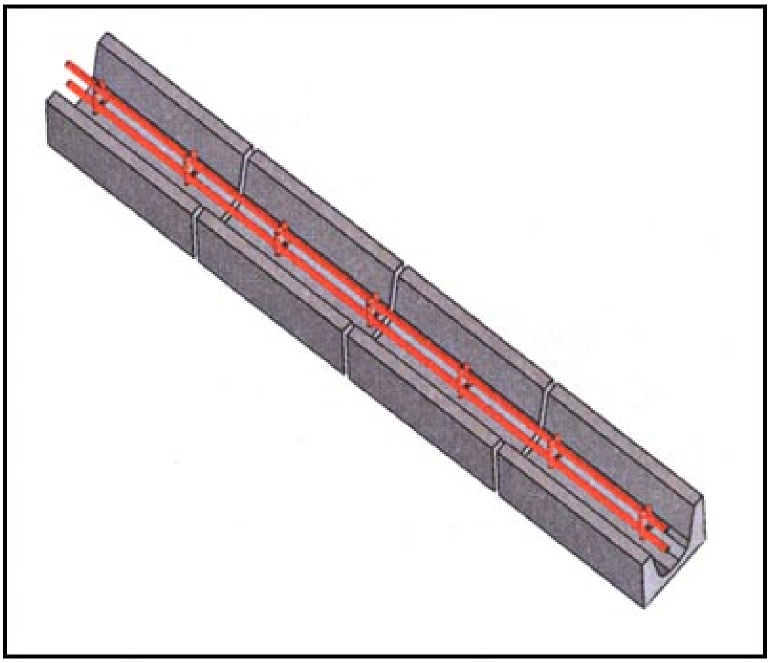
U–shaped HCB viewed from top

The U–shaped HCB has the same size as the full HCB; L=32 cm × W=16 cm × H=19 cm. It is used as a formwork for ringbeams & lintels and at the same time as a part of the wall.



U–shaped HCB viewed from bottom

Lintels and Ringbeams made out of u–shaped HCBS



4 U–shaped HCBs joined together as a lintel with reinforcement

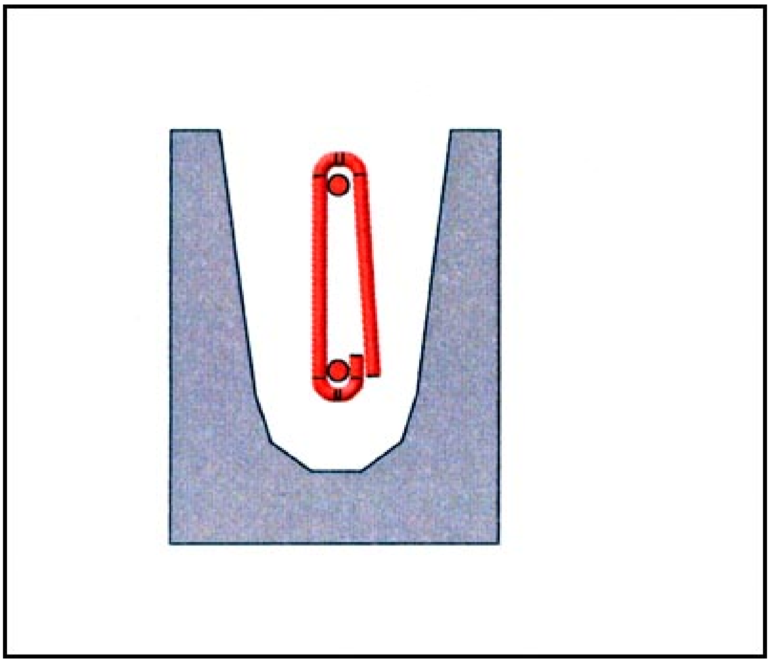
After the wall is properly erected the U–shaped HCB's are placed in at the hight of the ringbeam; the reinforcement bars and the concrete will be placed within the U–shape HCB according to the structural design.

Lintels will be prefabricated on a flat ground area in the same way as the ringbeams.

This technique avoids extra material for formwork.

The use of wooden formwork has negative effects on the environment. Moreover it requires skilled manpower and time to mantle and dismantle the form work.

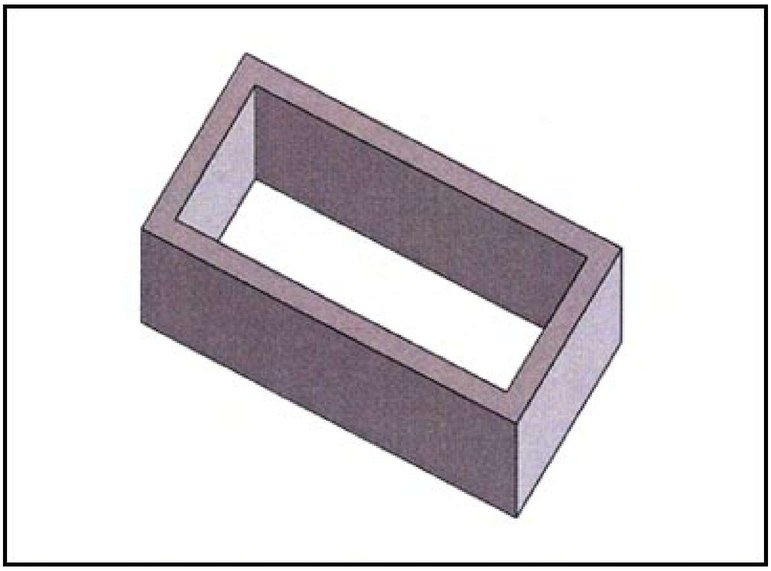
The concrete used for filling has to meet or exceed C25.



Section of HCB with typical placement of reinforcement

Column HCB

FIG. 8
SYSTEM OF COLUMN



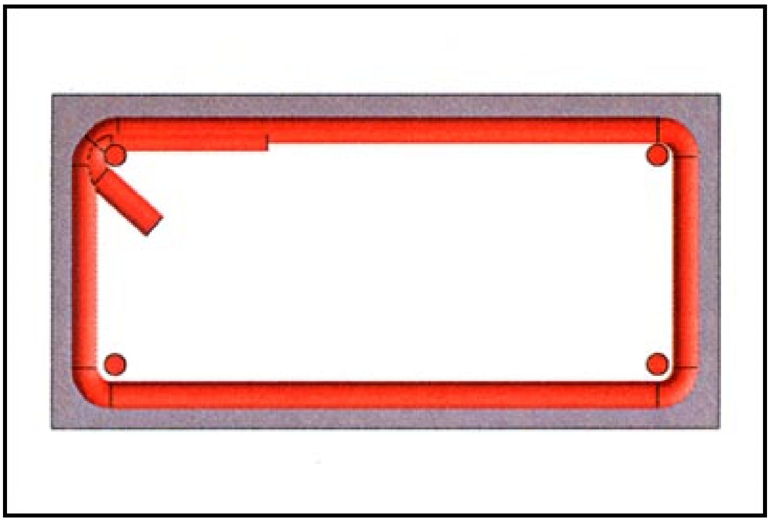
Column HCB viewed form top

The column HCB has a size of L=32 cm × W=16 cm × H=19 cm. It is used as a formwork for columns and at the same time as a part of the wall.

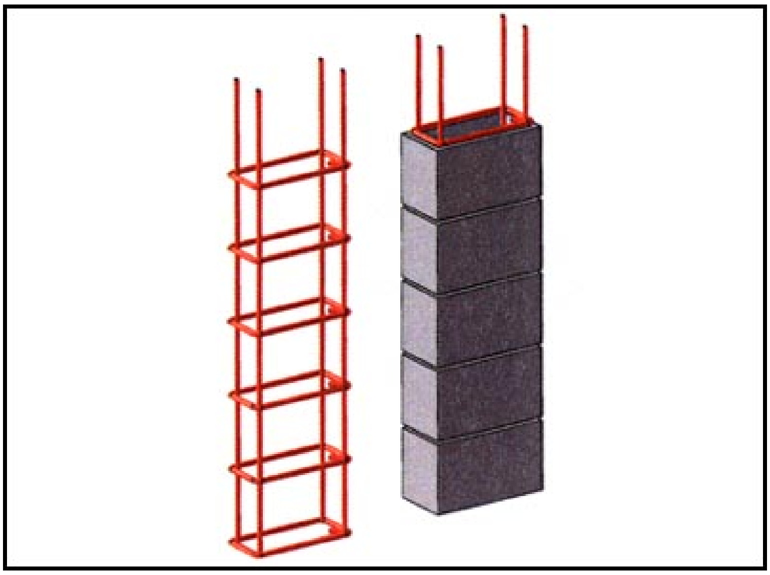
Columns made out of column–HCBS

After constructing the column out of column HCB's, one si the HCB at the bottom of the column has to be opened to remove the mortar that has fallen down during walling up. has to be done to ensure a reliable connection between th cast–in concrete and the slab foundation.

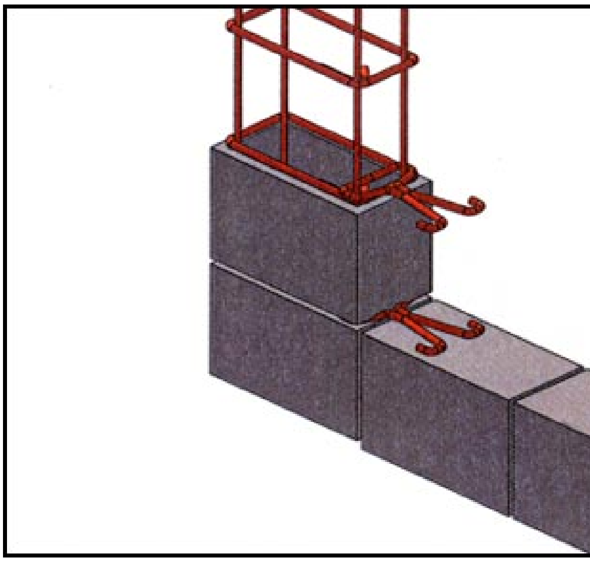
After walling up, the column is cast with concrete.



Column HCB with reinforcement



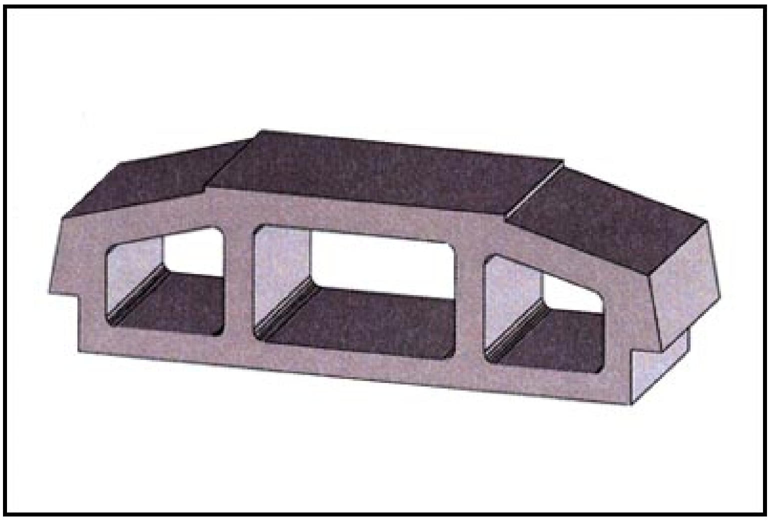
Column HCB with reinforcement



Connection inbetween column and w

Slab HCB

FIG. 9
SLAB HCB



The slab HCB viewed from top/side

This slab construction system, introduced by the Low–cost Housing Project, avoids formwork, reduces requirements of skilled manpower and time. The system has two major components: the pre–cast beam and the slab HCB.

The production of the slab HCB is done in the same way as production of wall HCB.

Basic Techniques Use and Description of Machinery and Tools 1

Hollow Concrete Block (HCB) Production

FIG. 10
HCB PRODUCTION

The machines used to produce HCBs are electrical vibrating machines which have 1.5 HP motor to make sure, that the vibration is strong enough to compact the concrete sufficiently in the moulds and to achieve the required strength.

Before starting production the different materials used to produce the HCB will be dry−mixed thoroughly on a clean and dry ground by hand. Then the mixture will be put in the mixer with the appropriate ammount of water required (water to cement ratio of 0.49 − 0.55). The mixture is inserted into the mould and vibrated for about 60 seconds before extruded as HCBs.

Except for the slab−HCB, the machines can produce three pieces at a time. The HCB ise transported by two people on a wooden pallet. The HCB remains on the wooden pallet for 24 hrs. Then it is be cured covered by a plastic sheet to enhance the curing process and preventing the water from evaporation.

Curing−time is at least 10 days before using the HCBs for construction.

It is important to write the date of production on the HCB so that the mason can easily identify the HCBs, ready for construction.

The materials required for the production of HCBs and their mixing ratio differs from site to site depending on the availability of the building materialsand the ratio that fulfils the required strength. This holds true for all types of HCBs production.

The average overall production is 1200 HCBs per day per machine.

The pictures show machines, used by LCH−Project.

The mould viewed from the top

The machine used for the production of HCBs

Filling in concrete while the machine is already vibrating

Concrete is filled up during compacting until the molde is filled

Removing the mould upwards

Clearing the top

Mortar and masonry work considerations

FIG. 11
MORTAR & MASONRY WORK

Mortar should be used economically.

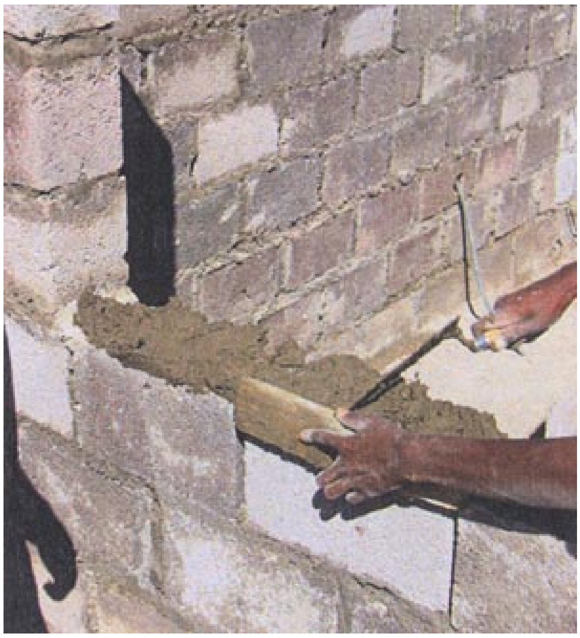
Therefore it is put on the top of the previous layer of HCBs in approx. 2 cm height. It has to be spread to the edges properly. A plain piece of wood helps to prevent the mortar from falling down. The upper surface of the mortar has to be rather rough to get a proper connection between the HCBs and to allow the mortar to spread into the holes of the upper HCB. It has to pressed down until the height of the mortar is reduced to 1 cm.

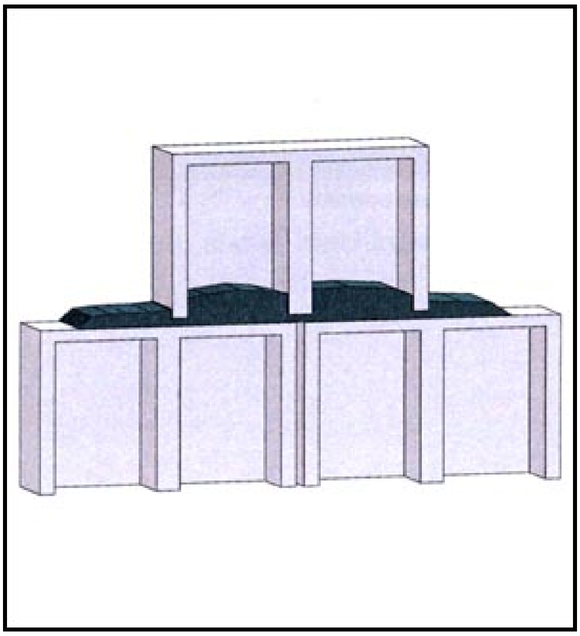
Walls constructed in this way can be considered as load bearing walls.

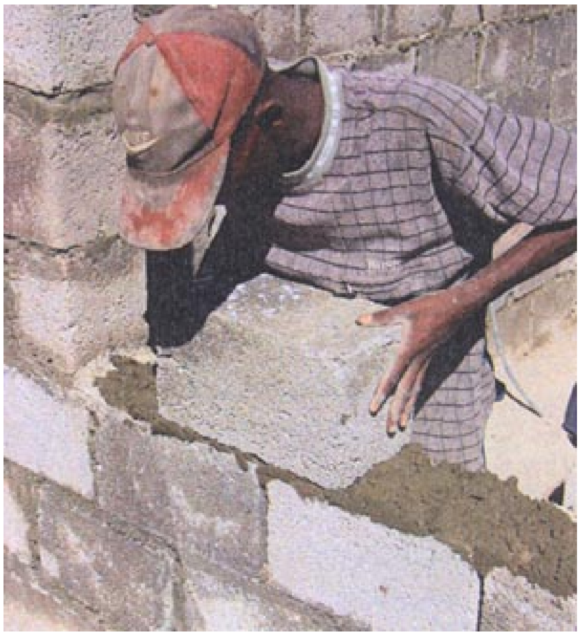
Mortar quality

The mortar used for walling up all types of HCBs has to be tested. The minimum pressure resistance of the mortar mixture has to be 170 Kg\sqcm or higher on the 7th day.


Putting the mortar on top of the last layer


Spreading the mortar to the edge, using a piece of wood


Section showing mortar spreading into holes of the HCB


Placing the HCB with the closed bottom up

Settlement area in Mekelle

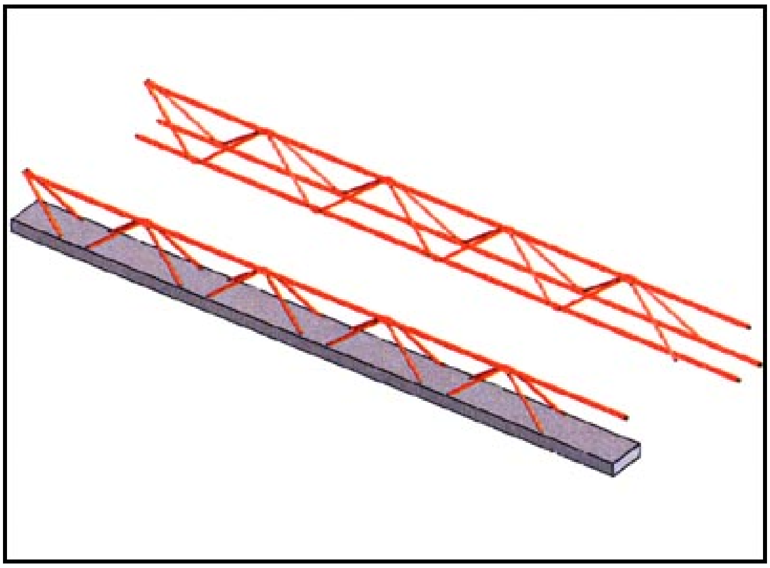
The same construction method is used for Ground + 1 Houses (Mekelle) and Ground–floor houses (Bahir Dar). The system allows also the construction of multistory buildings. The cost efficienty is even higher in multistory buildings, while the construction time can be shortened and the material wastage will be considerably reduced.

Construction of Houses in Bahir Dar

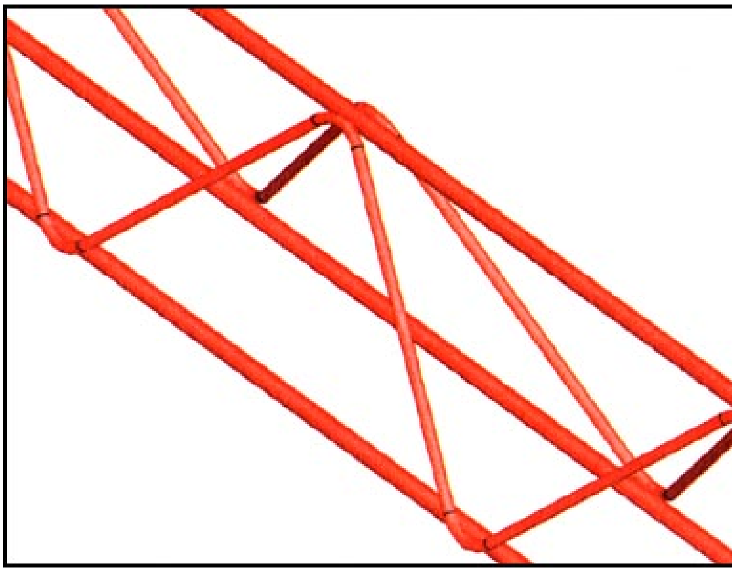
Building Parts 2

Precast beams

FIG. 12
PRECAST BEAM



The pre−cast beam (bottom) and the reinforcement itself (above)



Detail of the reinforcement

In the pre−cast beam production, the reinforcement has to be properly bent. Especially for the stirrups, the diameter for bending has to be 4 times greater than the diameter of the stirrup itself.

The stirrups must be welded at the top with the main reinforcement.

The pre−cast beam is then casted by using a mould and a vibration table so that the concrete is well compacted. The beam production and transport to the place where it is going to be cured can be done by four people. (ref. to figs. on page 17)

After having finished the production of the components, five labourers can do the proper laying of the pre−cast elements and slab HCB in one day.

Considering 40 sqm of slab, the temperature reinforcement, the electric and sanitary lines and also the formwork around the slab can be done within 2 days.

One can start the construction of the walls on the slab three days after casting of the concrete.

With the usual method one has to wait 21 days without dismantling the formwork hampering the activity that could be done above or below the slab.

Basic Techniques Use and Description of Machinery and Tools 2

Bending reinforcement for precast beams

FIG. 12
PRECAST BEAM

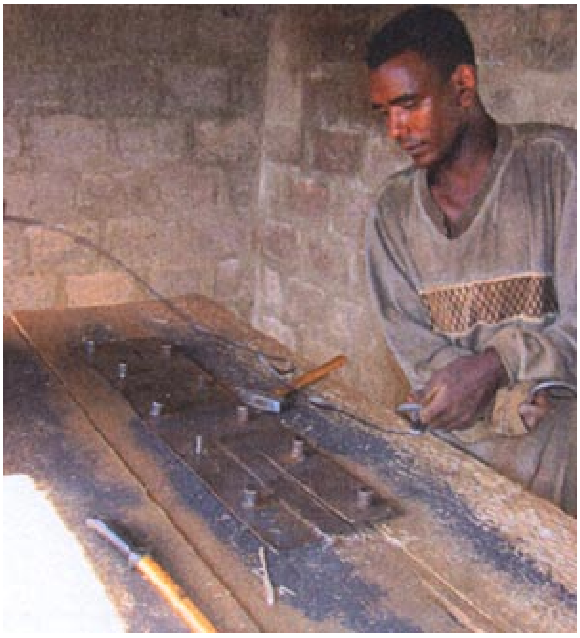
Bending of reinforcement can quickly be done by using formwork consisting of a metal plate with bolts welded on it.

The bolts must have a diameter corresponding to the minimal bending radius of the used reinforcement−bars.

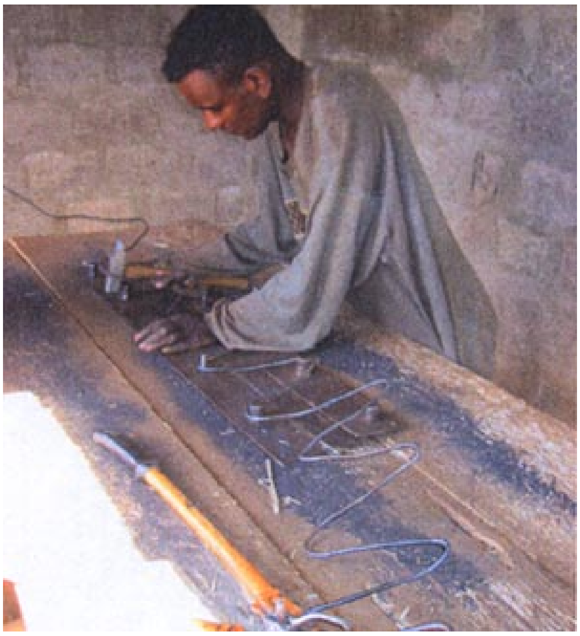
Normally the diameters of the bolts have to be four times bigger than the diameter of the bars used.

After the stirrup is formed over the length of the mould, the stirrup can be put off and re−fitted so that any length of stirrup can be produced.

Forming the stirrup



Removing a finished segment



Starting the new segment

Model of the formwork with ready–bent stirrup on it

Vibrating table

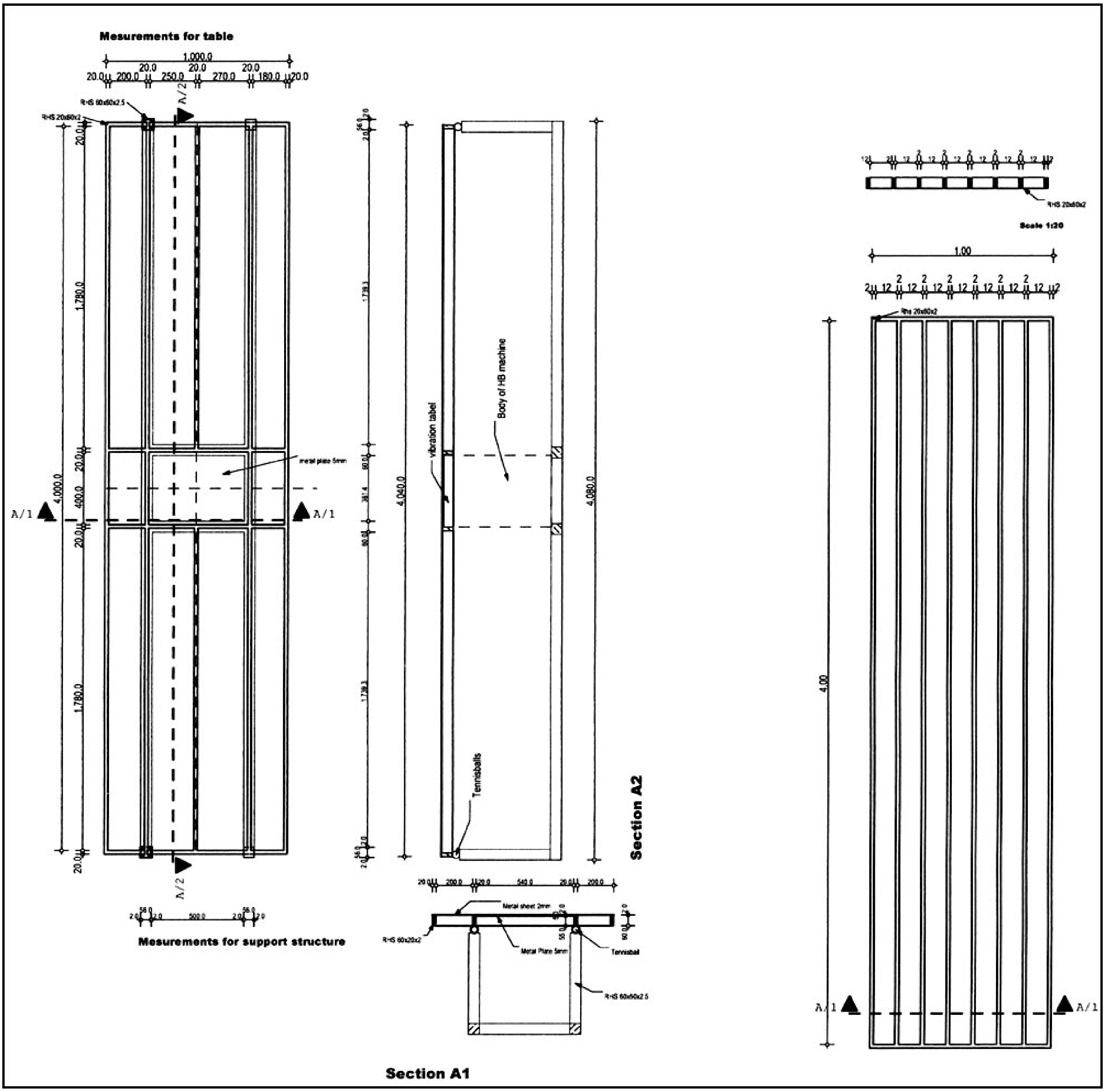
FIG. 13
VIBRATION TABLE

The vibrating table is used during casting of the concrete for the precast–beams.

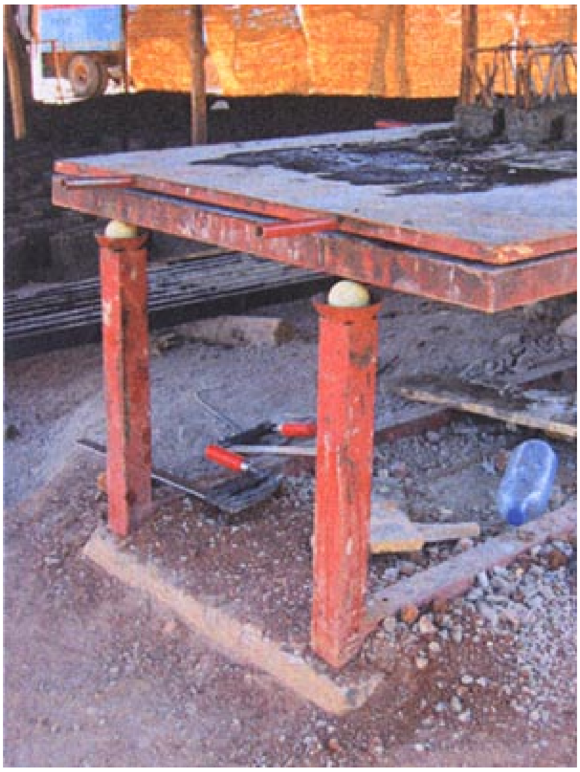
It consists of the vibrating–machine, which is similar to the one used for HCB–production, and a metal table as shown in the drawings below.

The table is trussed at the edges by four billiard balls lying in hollows to enable it to move horizontally free.

In addition, a mould is used to cast seven beams at once. It is also shown in the drawing below.



Drawings of the vibrating table



Supports with billiard balls

Filling in concrete by hand

The vibrating–machine

Spreading the concrete, using a bend bar

Mould for the pre−cast beams

The precast−beams after removing the mould

Hooks for holding parts of formwork together

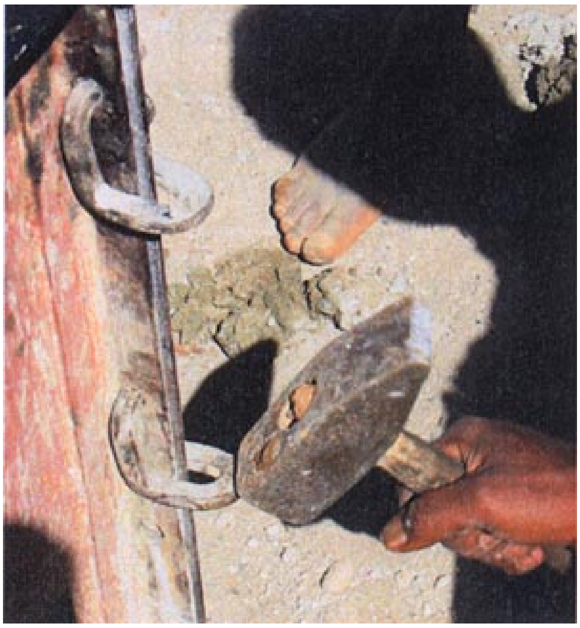
FIG. 14
HOOKS FOR FORMWORK

Clamps are used to hold parts of formwork together.

One side is rounded and tapered to make insertion into the drill−hole easier. The other side is bent by 180 degrees and flattened. This side of the clamp provides a pressure on the parts of the formwork to hold them tightly together.

a clamp

Inserting the clamp into a drill−hole of the formwork...


... And locking it by rotating it by 90 degrees


Four clamps mounted in edge–position using an angle bar


Two clamps mounted on formwork for foundation

Formwork for foundations and slabs

FIG. 15
FORMWORK

The formwork for foundations and for slabs is the same. It consists of a metal panel with a frame welded on it to achieve stability. The frame has got drill–holes for the clamps.

In conjunction with angle bars, two pieces can be used to form an edge. They can be mounted side by side or on top of each other.


A formwork for a slab, fixed by additional wires bound to the reinforcement of the slab


The edge of a formwork–assembly for foundation


A formwork for foundation, panels mounted on top of each other, side by side and at the edge

The Manhole

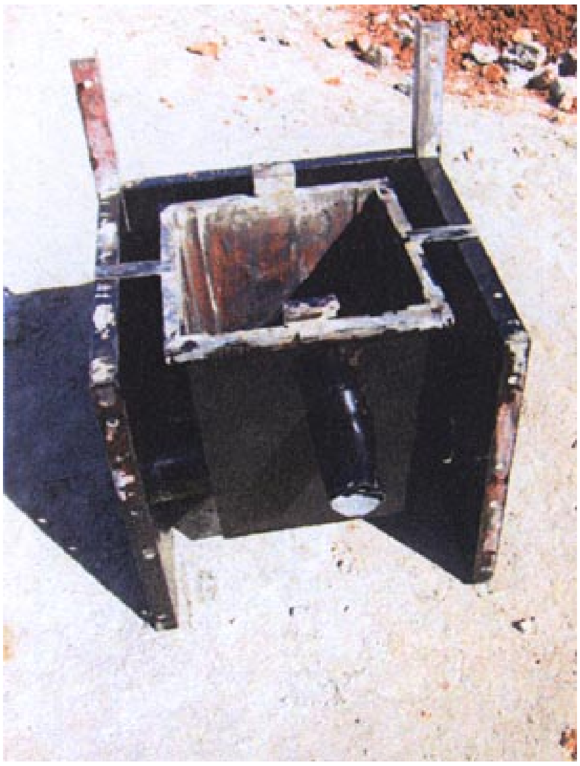
FIG. 15
FORMWORK MANHOLE

There is also a formwork for the manholes. It consists of four metal side–panels, two plastic pipes and a rectangular pot. The side–panels are fixed by four angle bars in the corners using clamps as described above. The pipes are fitted on different levels, so that back pressure can not reach the intake.

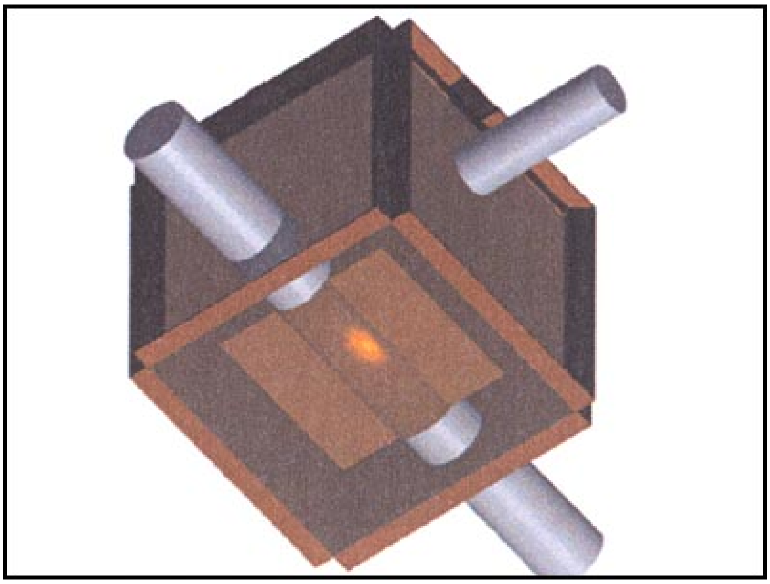
The pot is slightly tapered and has a groove at the bottom to form a chute for the future catch drain.

All parts are treated with waste oil to make removal easier.

One has to be sure to make the pit for the manhole big enough to be able to draw out the pipes after casting the concrete. Moreover, one has to foresee enough space in the pit for 3 persons to place and remove the formwork.

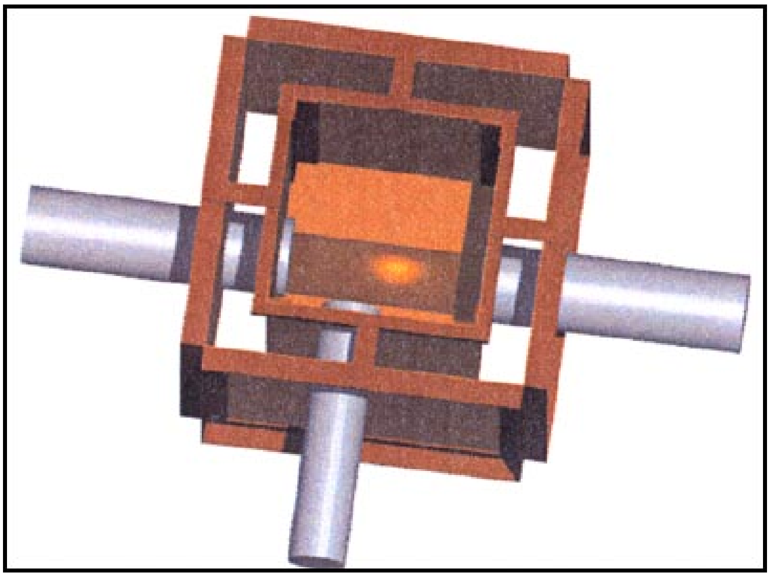


Formwork for the manhole, viewed from the side of intake (front panel removed)



Bottom–view of the mould with frog for the chute

The mould viewed from the side of the catch drain (front panel removed)



The frog for the chute viewed from top

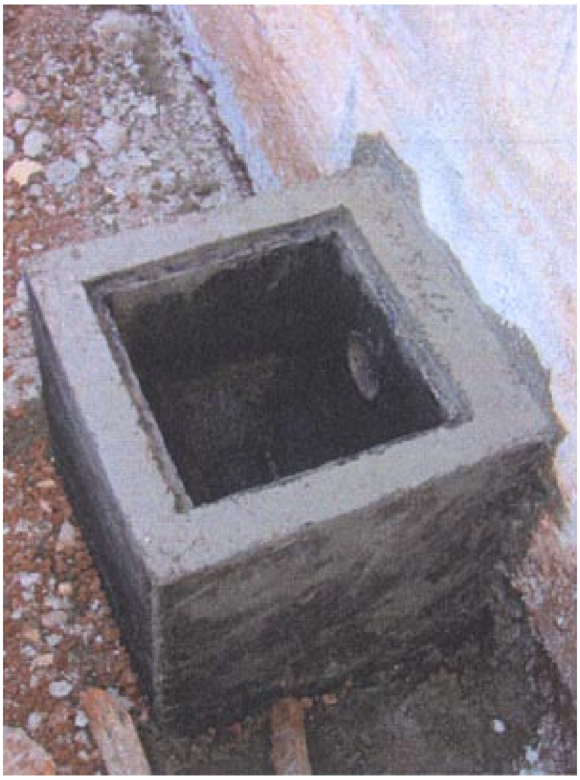
Viewed from top (panel of intake−side removed)

Concrete spacers for fixing position of reinforcement

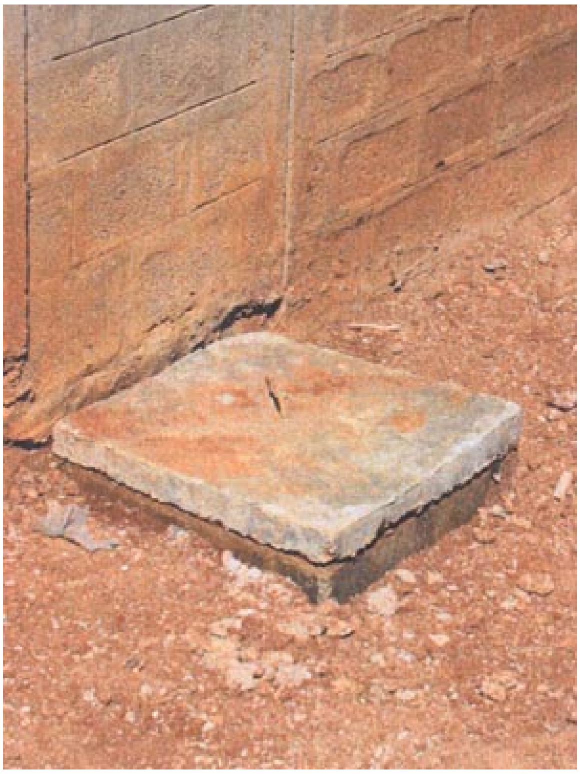
FIG. 17
CONCRETE SPACER

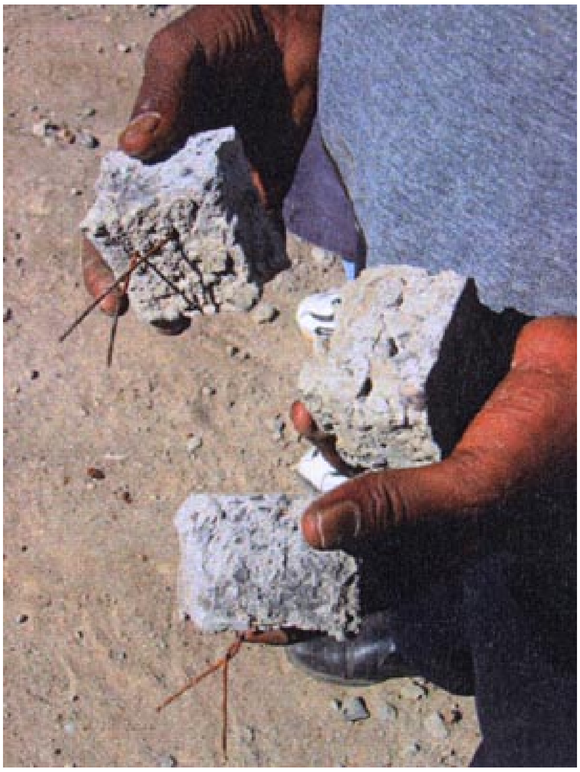
In the execution of foundations and slabs concrete spacers are used to hold reinforcement in position and to assure the required cover. Cast−in wires are used to fix them to the reinforcement bars.

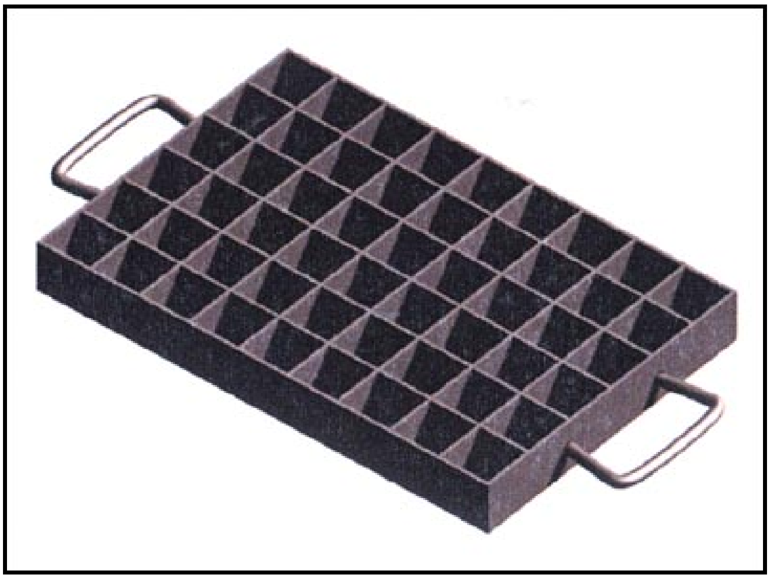
The spacers are produced using a metal mould. Concrete is filled in and during compacting with the vibrating table, the wires are inserted.


The cast manhole


The pit for the manhole


The concrete spacers with wires for fixing them

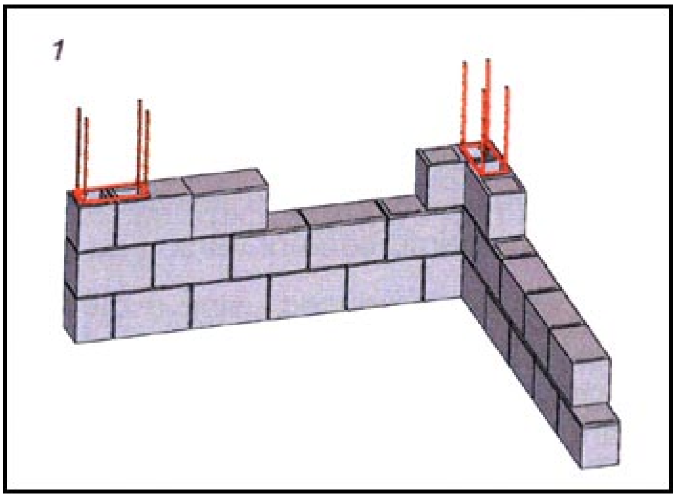

The manhole covered with a precast lid

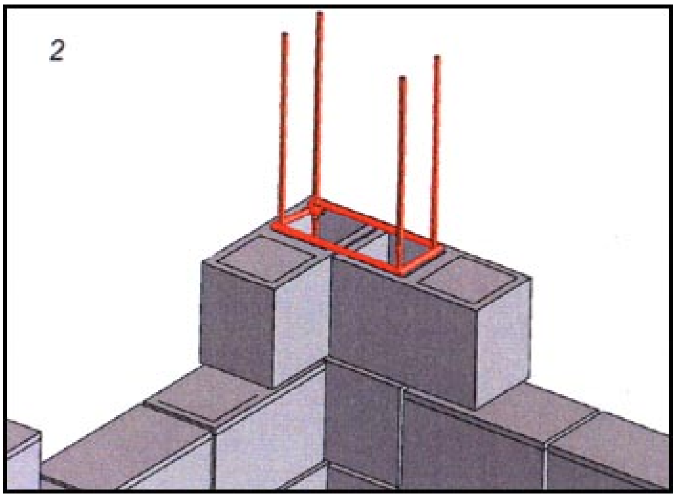


The mould for the concrete spacers

Construction Process

An exemplary construction process



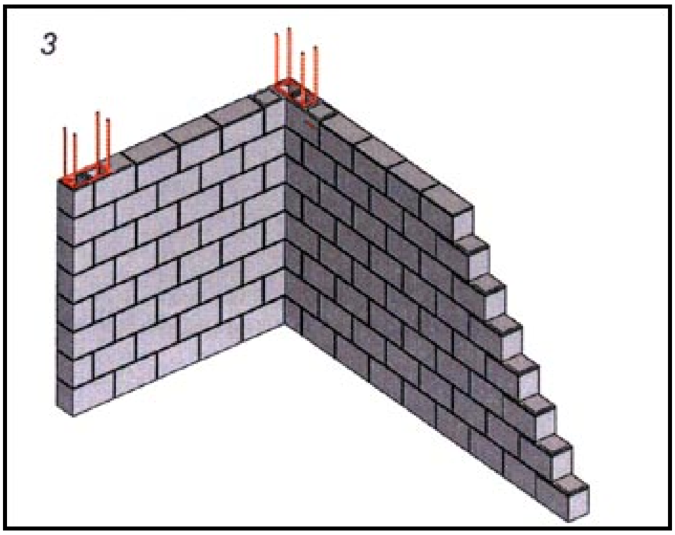


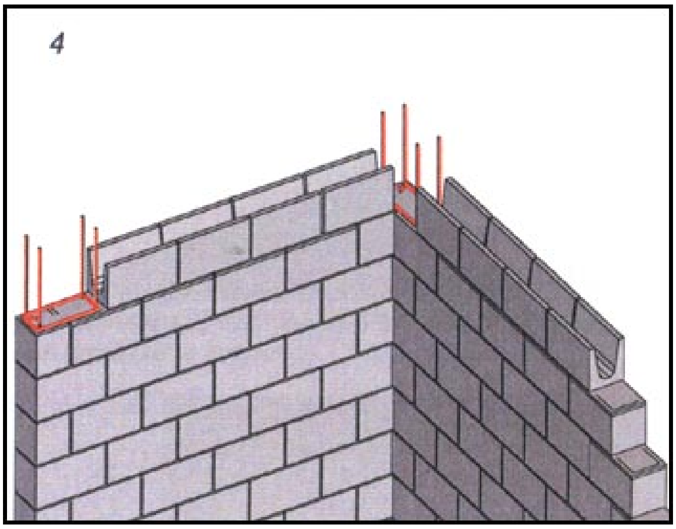
The following describes, how an exemplary construction process is implemented, using the building parts mentioned before.

During walling up, the columns are integrated into the wall by using column HCBs. The positions of the columns has to be calculated by a structural engineer. The structural design depends for example on the number of storeys to be built and the possibility of earthquake exposure.

Reinforcement is placed inside the column HCBs. After 10 layers of HCBs are erected they have to be filled with concrete C 25.

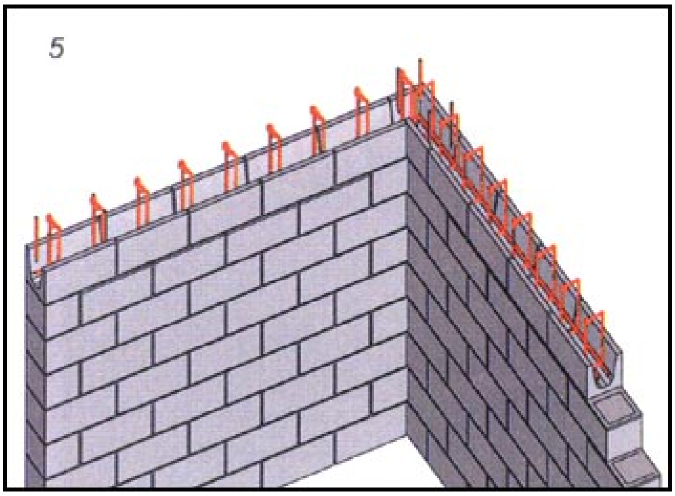
Stirrups are placed within the mortar joints as shown in the drawings.

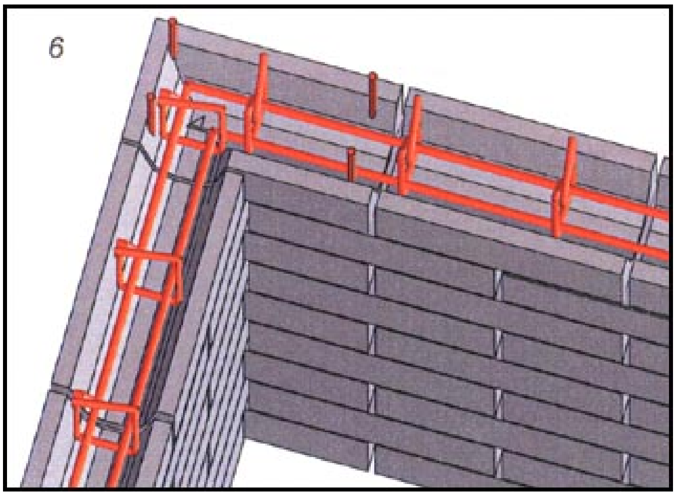




When the wall is erected, a ring–beam has to be fixed. Therefore U–shaped HCBs are used as part of the wall and even as formwork for the concrete.

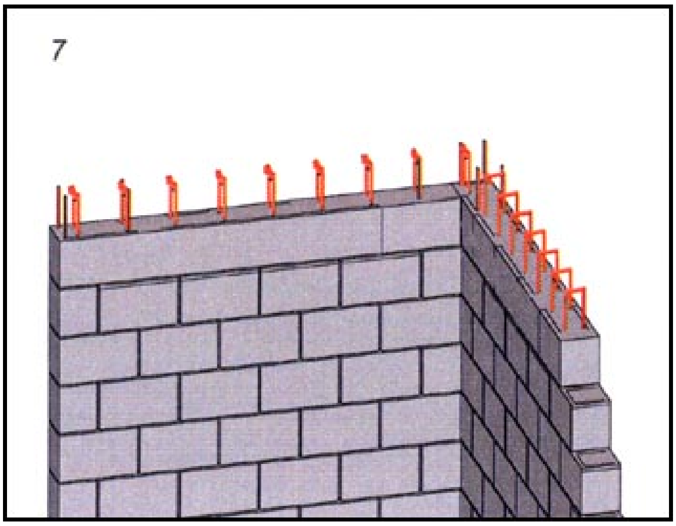
U–shaped HCBs are placed on top. Where the reinforcement of the columns is placed, the bottom of the U–shaped HCBs have to be cut. The reinforcement bars of the columns have to be bound into the reinforcement of the ring–beam. The overlap length of the column reinforcement has to be at least 80 cm.

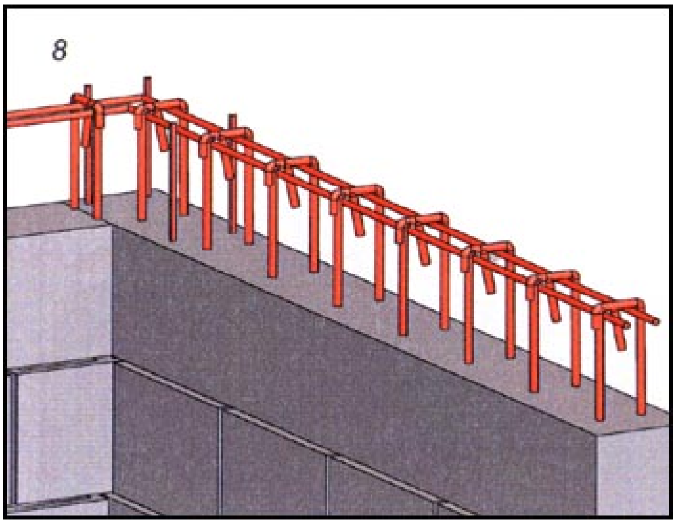




Reinforcement bars are laid into the U–shaped blocks.

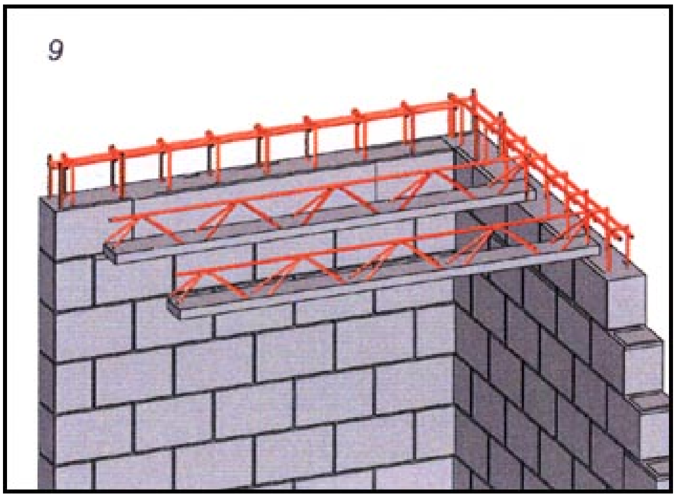
Stirrups are placed every 20 cm. The length of these stirrups depends on the height of the slab to be built and has to be designed by the structural engineer.

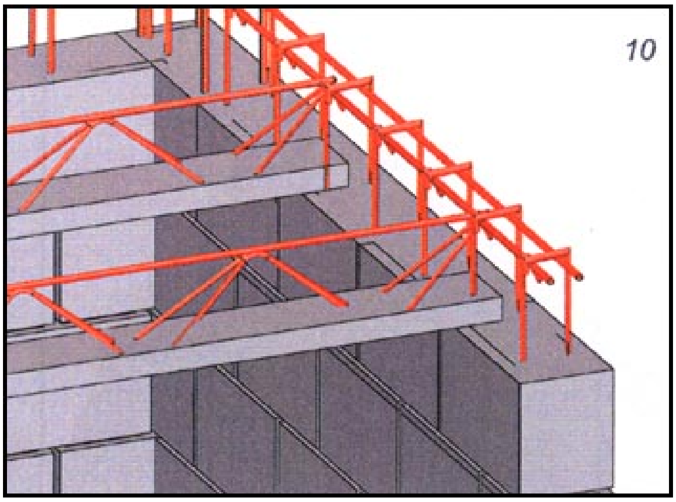




The U–shaped blocks are filled with concrete, min. quality C25.

The upper reinforcement parts for the slab are placed in position.

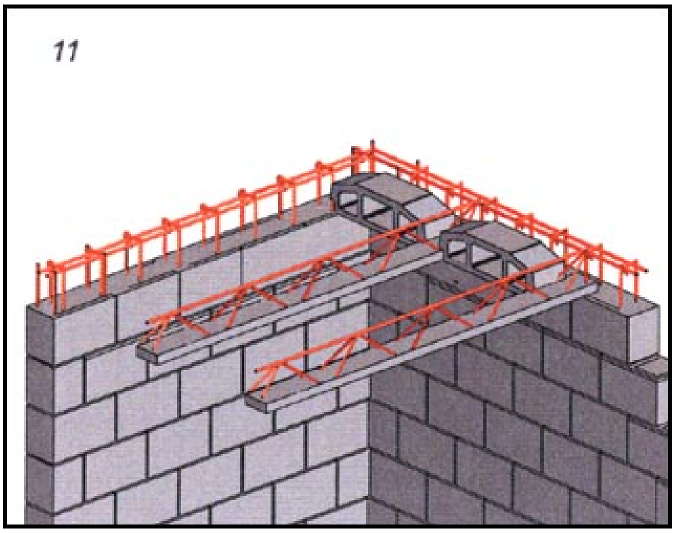


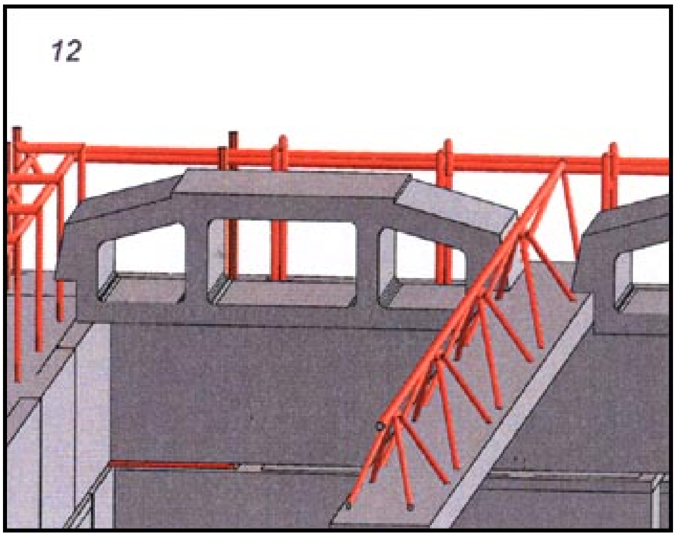


In a next step, precast beams are laid upon the ring–beam. The distance between the beams results from the width of one slab–HCB at its bottom plus a tolerance of 0,5 cm on both sides. That means clear distance between beams of 50,5 cm.

The distance between the ring–beam and the first beam has to be 47,5 cm resulting in an overlap for the slab–HCBs of 3 cm.

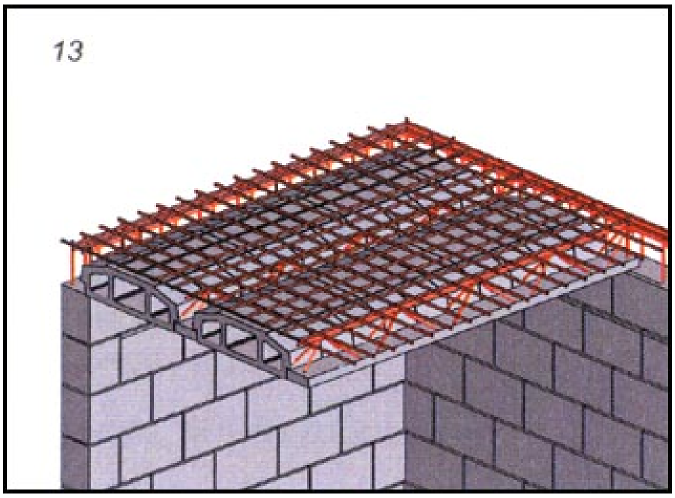
Overlap at the end of beams over the ring–beam has to be at least 10 cm.

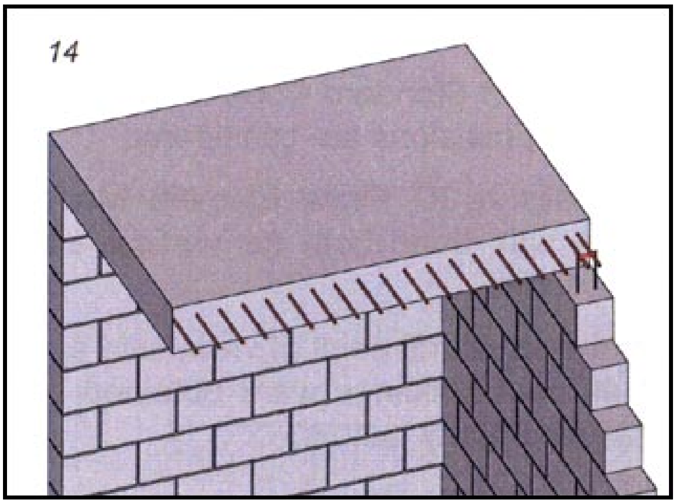




The slab–HCBs are placed between the beams or between beam and ring–beam.

One has to be sure of the proper placement of the slab HCB.



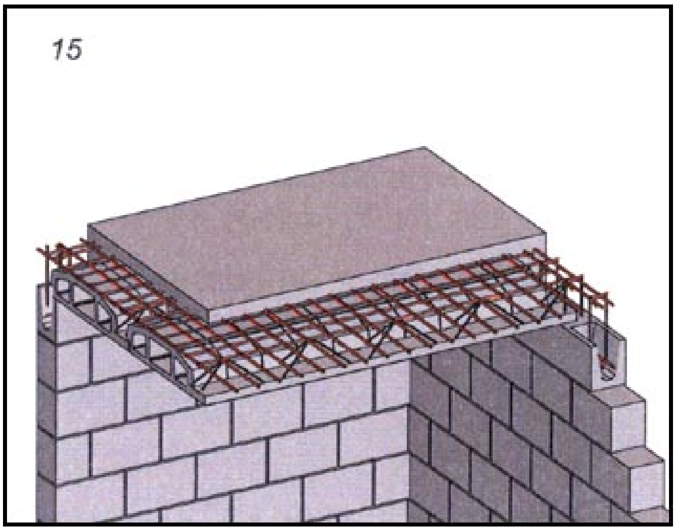


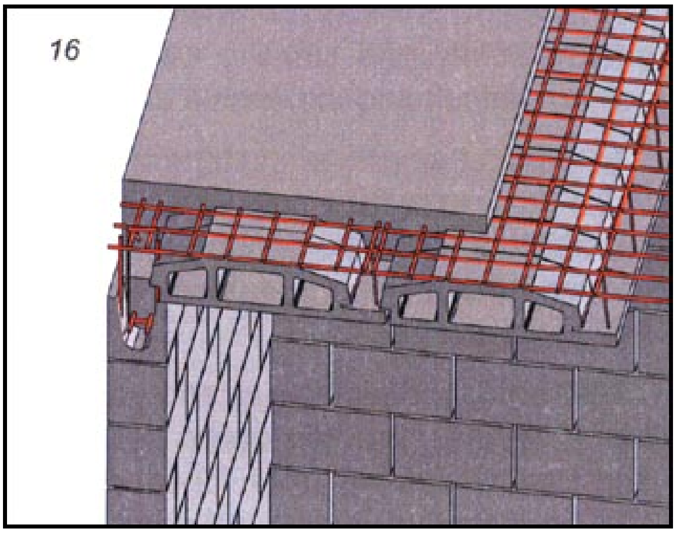
When all slab–HCBs are placed, the result will be also a formwork for the concrete–filling of the future slab.

A temperature reinforcement is to be laid on top of the HCBs with properly bent hooks at the ends of the reinforcement bars. The diameter of the reinforcement bars is 6 mm.

Formwork panels are placed at the outer edges of ring–beams to complete the formwork.

Concrete filling is done on top of beams and slab–HCBs. The quality has to be at least C25.





These drawings are schematic drawings of the final construction. A part of the slab's concrete filling is cut away to illustrate the position of reinforcement and slab−HCBs within the concrete filling.

Structural Design

Structural design

The structural design for the project was done with the main aim of providing safe and cost efficient housing.

The Ethiopian Standard Code of Practice, ESCP−95, provisions are considered.

Additionally a 3D Finite Element Model analysis was done both for vertical and seismic loads.

From the structural point of view, safe and cost efficient buildings were obtained by considering many factors.

The major factors are:

Pre cast beams and HCB rib systems are used to avoid slab−/beam formwork and to reduce the number of skilled carpenters.

For up to G+1 buildings no column formwork is required as the columns are embeded in the Concrete Hollow Blocks.

Modular structured elements are used to simplify work and production of pre cast beams and Concrete Hollow Blocks.

Simple structural systems are used to ensure safety and stability without requiring difficult and expensive details.

An optimal structural system and layout is used to reduce cost without compromising quality. The optimal system is chosen after making trial and error with many alternatives.

Different foundation types and embedment depths are considered and the one that is optimal from function and cost aspects is selected and adapted.

The reduction of construction time is achieved by using simple pre cast systems which were instrumental in reducing cost and enables better quality control.

Analysis of Slab

The slab is made of precast beam systems that are used together with hollow blocks. The pre cast beam is spaced at an interval of 625 mm.

Topping Reinforcement

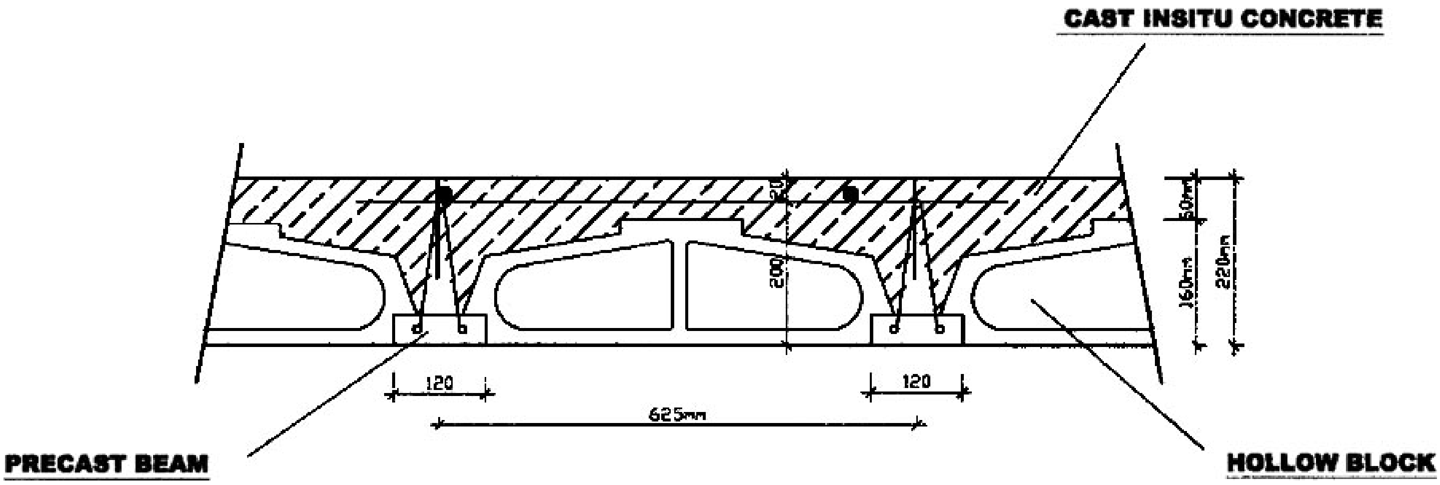
The topping is a one way slab that is supported on the precast beams.

Taking a one meter strip and analyzing the slab it could be shown that the area of steel to be provided is minimum. The shear should also be checked because of local shear developments due to small slab depth.

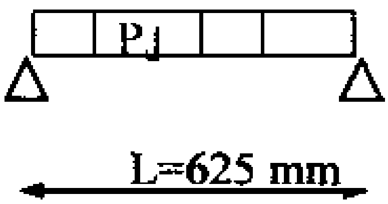
The maximum shear developed vmax = pd/2 is checked against the capacity of the section and it is determined whether shear reinforcement should be provided or not. In the present example no shear reinforcement is provided since the applied shear is less than the capacity of the section.

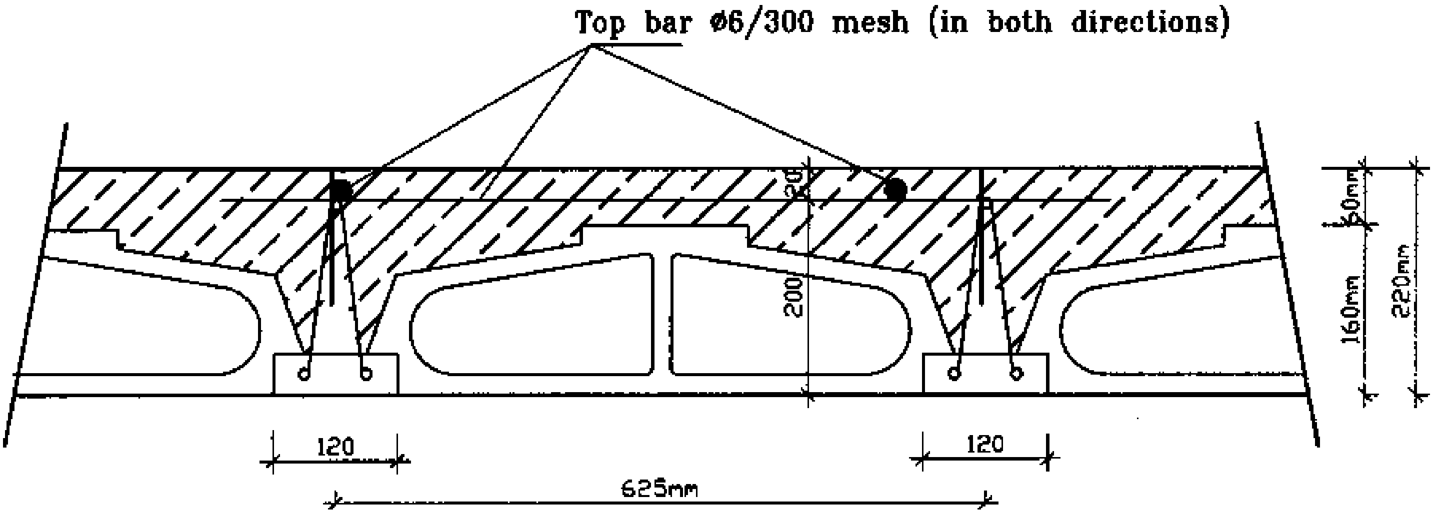
Minimum reinforcement from the code suggests that a reinforcement mesh providing in each direction a steel area not less than 0.0167 of the section of the slab.

A typical section of a slab with minimum reinforcement is shown in FIG−1s.



Typical Slab Section





FIG−1s section of slab at final condition

Analysis of pre−cast beams

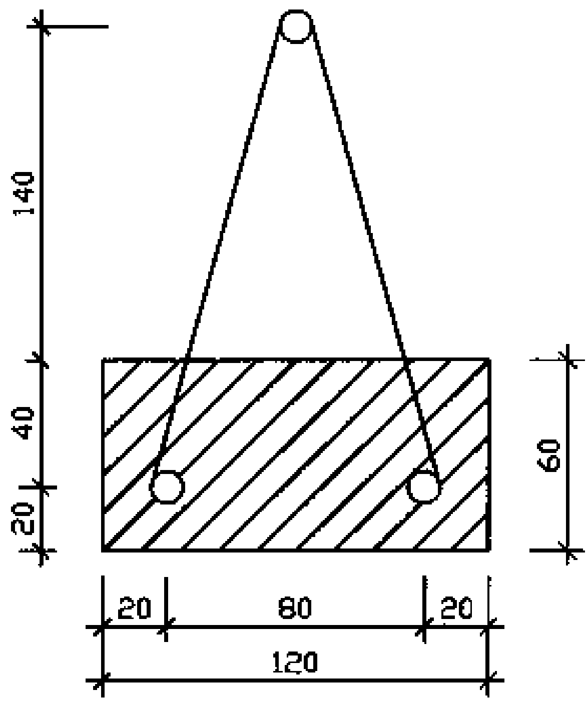
The analysis of the pre−cast beam is divided into two parts:

1. Initial condition
2. Final condition

Initial condition

For smaller spans up to 4 m the precast beam has a concrete section of 60 mm depth and 120 mm width at initial condition.

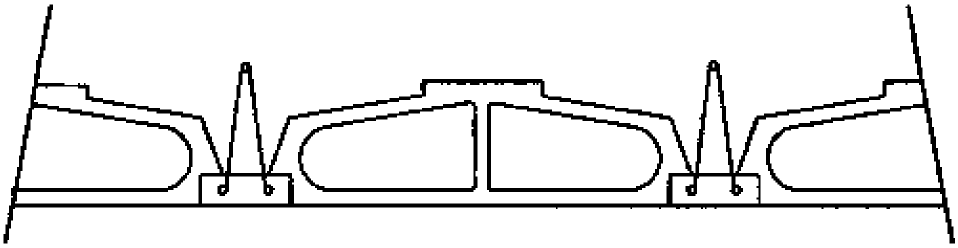
For larger spans up to 5 m a concrete section of 80 mm depth and 120 mm width has been used. For initial condition this pre cast beam is laid on the main beams supporting it. Since the initial condition is a transistory period the depth of the precast beam is chosen fulfilling the flexural requirement which is shown later. A typical precast beam section is shown in Fig.2s.



FIG−2s Detail of pre−cast beam

This precast beam is to be supported at midpoints in order to meet it's design requirements. A typical section of a precast beam with the hollow blocks at initial condition is shown in FIG−3s.

The pre−cast beam at initial condition is designed to carry the load that comes to it, for live load and dead load. It is provided with shear reinforcement that is compared with the code requirements and the load that comes to it.



FIG−3s precast beam and HCB arrangement before top slab casting

Typical analysis of a precast beam at initial condition

Loading: dead load (gk):

– precast beam: 1.3*.12*.06*25	=	x
– concrete block: weight of hollow block	=	y
		g_k

live load (qk):

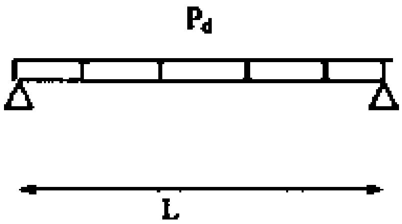
– depends on the purpose of structure	=	q_k

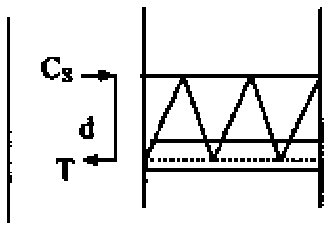
design load: p_d = $1.3g_k + 1.6q_k$

System:

$$M_{max} = \frac{P_d * L^2}{8}$$

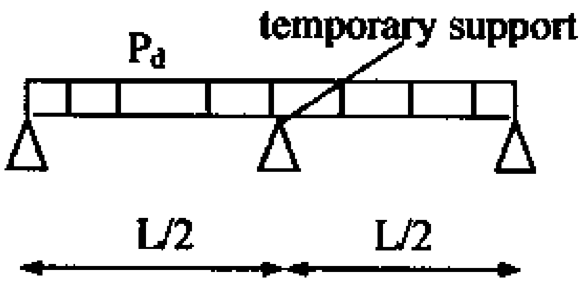
$$c_s = \frac{m}{d}$$





The compressive force Cs should be multiplied with the buckling ratio of the reinforcement and it's divided with the area of the re−bar which is checked with the allowable stress. The bottom reinforcement should be able to carry the design moment.

In some cases where the span is longer the precast beam is not able to carry the design moment, therefore a temporary intermediate support is provided. The analysis is done as shown beside.



$$M^{+} = \frac{9P_d * (L/2)^2}{128}$$

$$M^{-} = \frac{P_d (L/2)^2}{8}$$

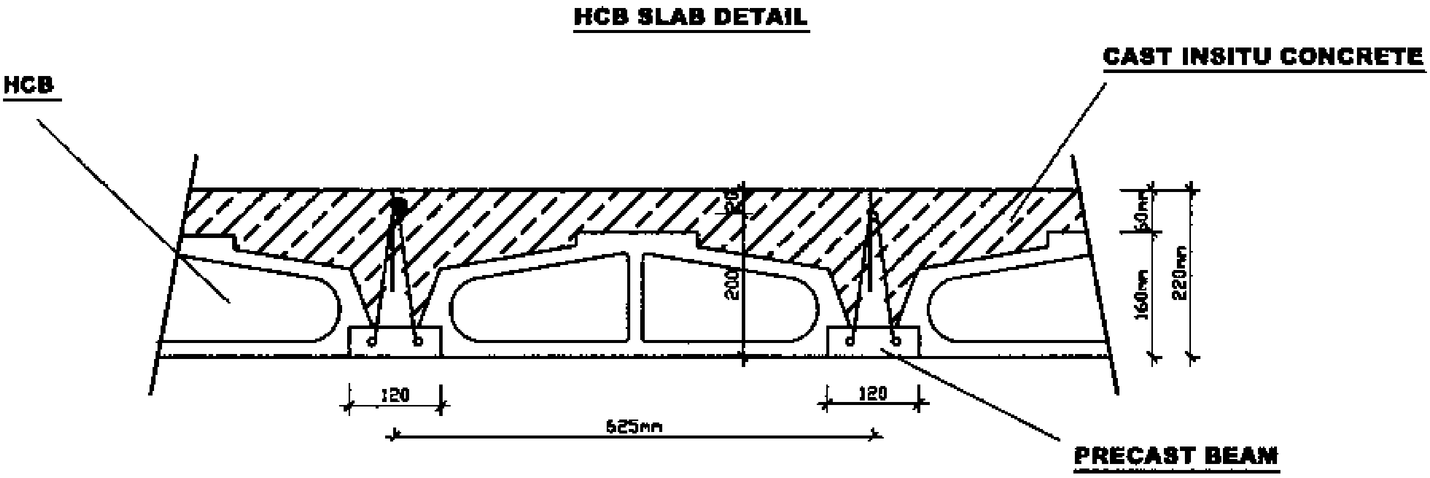
The corresponding Cs is calculated and it is divided with by the area of the reinforcement which is checked against the allowable stress capacity of the reinforcement. This is provided as a bottom reinforcement.

A negative moment developed at the temporary support. In the same case the stress coming to the reinforcement should be less than the allowable stress.

<u>Checking for shear</u>

The shear force that comes to the beam is calculated for maximum value. (v_{max})

v_{max} is distributed to the diagonal reinforcements and the appropriate re−bar is selected which can carry the induced stress.



Fig−4s section of slab at final condition

Final condition

The section of the slab at final condition is shown in FIG−4s. The analysis is done as follows.

<u>Loading:</u>

dead load (g_k):

− precast beam: 1.3*.12*.06*25	=	x
− concrete block + cast insitu concrete	=	y
− floor finish + partition	=	z
		g_k

live load (q_k):

− depends on the purpose of structure

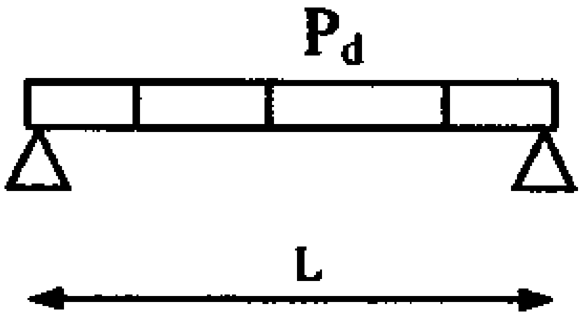
design load: p_d = $1.3^* g_k + 1.6^* q_k$

System:

$$m_{max} = \frac{P_d * L^2}{8}$$

d = D−d'−cover

$$\mu_{us} = \frac{md}{f_{cd} * b * d^2}$$



For this value of μ_{us} a graph is read from EBCS code and the value of k_x is read.

$k_x = x/d$

from this we can get the value of x.

This value is checked against the centroidal axis of the beam and it determines whether the beam acts as a T−beam or a rectangular section.

The same graph is used to determine the value of k_z.

$A_S = M/K_Z{}^*d^*f_{yd}$

The above equation is used to determine the area of steel.

Check for shear

The shear force that comes to the structure equals

$v_{sd} = p_d \, ^*l/2$

This value is compared with the code requirements of the section which are

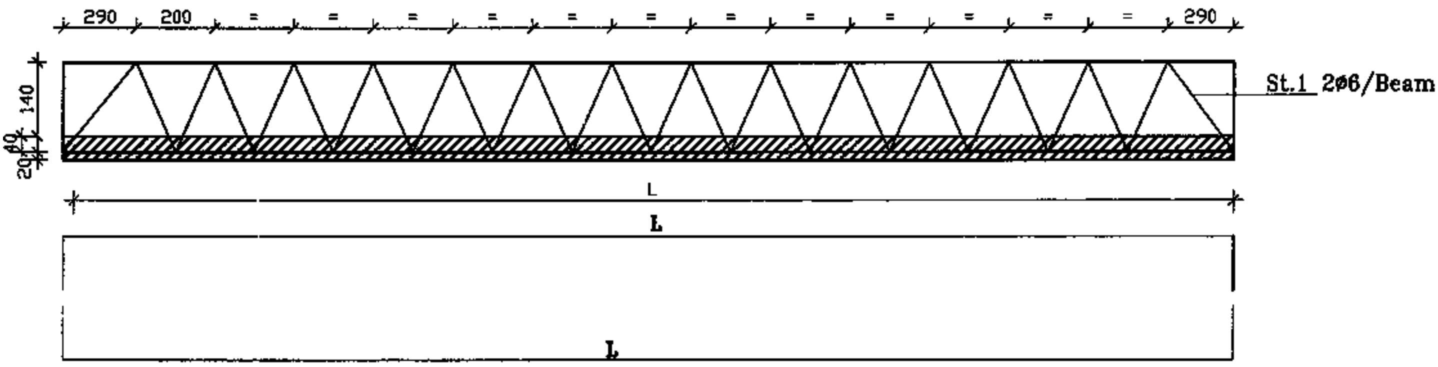
1. v_{sd} ? 2/3 V_{RD}
2. $2/3v_{RD} < v_{sd}$? v_c
3. $v_{sd} > v_c$

then the appropriate shear force equation is used to determine the reinforcement to be provided. All equations are checked against the requirements of the code.

The longitudinal section of a typical precast beam is shown in FIG−5s.

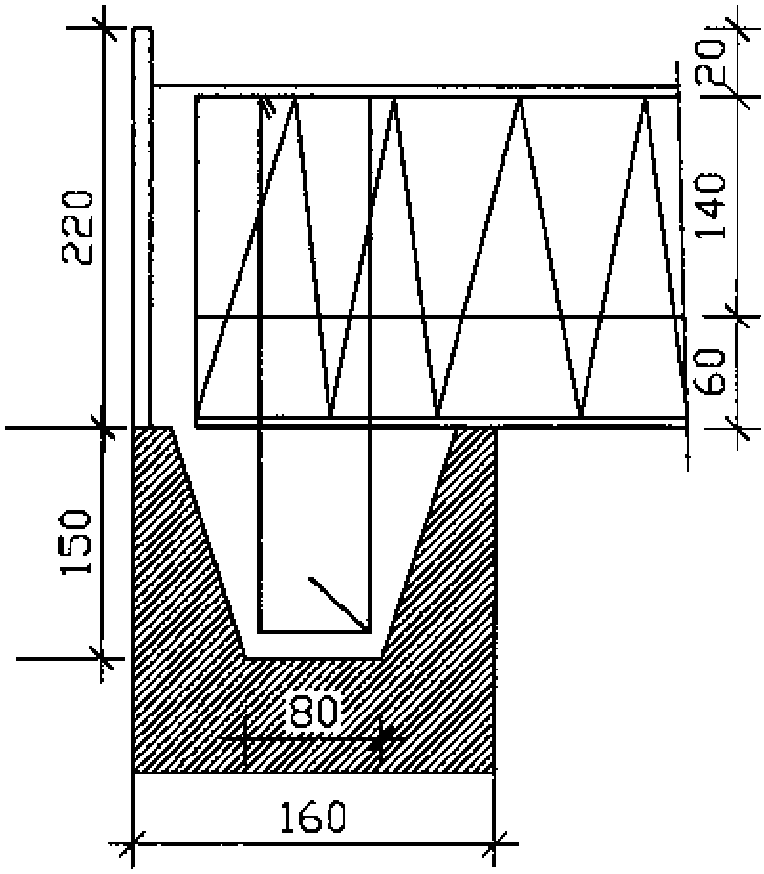
The slab system's depth varies depending on the span. For example a depth of 220 was used for a G+1 building with a maximum span of 4.0m. For longer spans a bigger depth may be used.

A depth of 280 mm was used for apartments with 5.0 m span in Addis Ababa.



FIG−5s typical longitudinal section of precast beam

Analysis of beams and colums



FIG−6s typical connection detail of U beam and pre cast beam

The beam is the primary structure that supports the pre cast beams.

There are two types of beams used in this approach

- – Beam in U shaped HCB (supported by the wall)
- – Beam without wall support

Beam in U shaped HCB

The U−beam carries load that comes from the precast beam and wall above and transfers it to the wall below and columns.

Since it is continuously supported by the load bearing wall below, minimum longitudinal and shear reinforcement is provided according to EBSC−2. Unless and other wise the lateral force is governing.

Beam without wall support

Such beams are used when there is no wall support due to openings. A small formwork is provided under this beam. The analysis of this beam and columns and the frame as a whole is made in a software using a 3−D model. (SAP 2000 was used in this case)

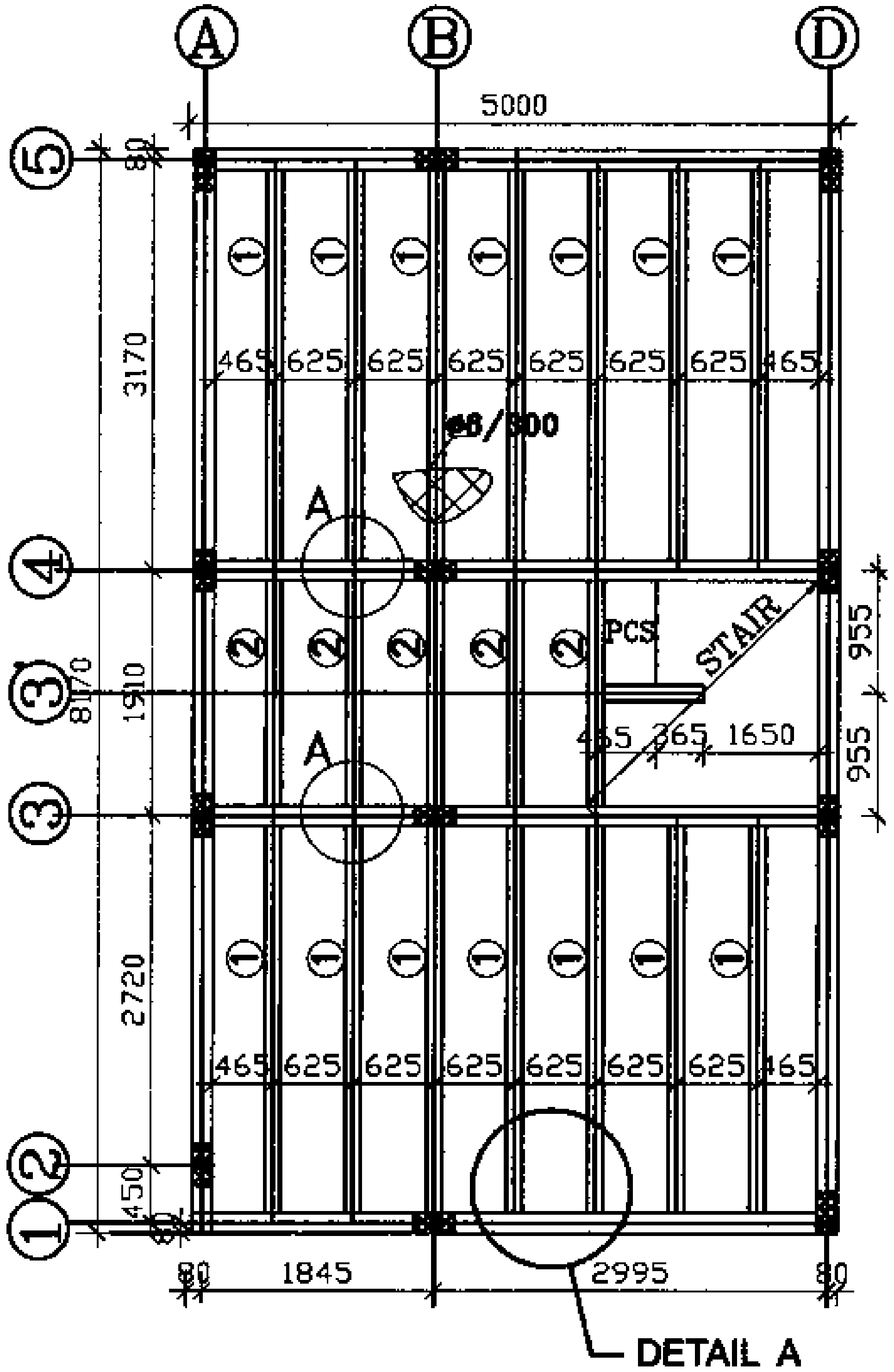
The column is totally braced by the wall. To consider this effect the wall is modeled together with the frame element in the analysis using FEM.

A typical section of the U−beam supporting a precast beam as shown in FIG−6s.

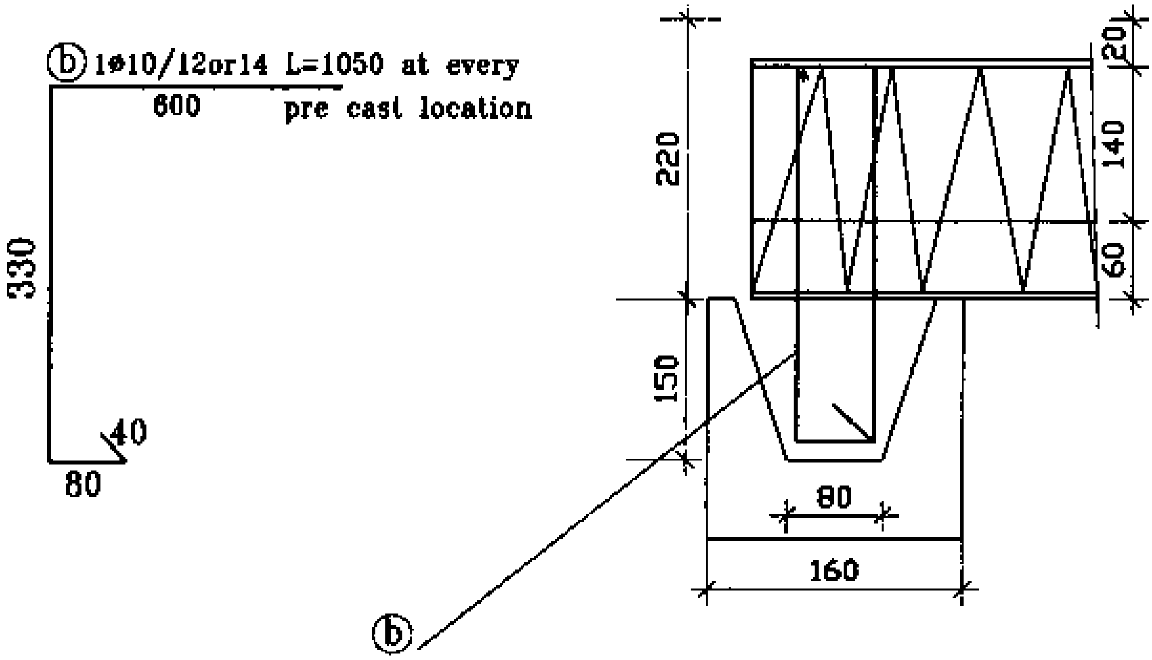
The layout of the pre cast beam is shown for a typical G+1 house in Fig−7s.

The pre cast beams are connected with reinforcement hooks inorder to take care of small negative moments that might develop and to insure stability. In the same way precast beams at edge are provided with additional negative reinforcements to take care of cracks that might develop by a negative moment.

The additional re−bar is shown in FIG−7s



FIG−7s typical pre−cast beam layout



DETAIL A: Additional re−bar at edge

3D modelling

Modeling is done in the SAP analysis by using Finite Element Method. All joints in plan are horizontally constrained so that each member will have equal displacement and no compression force developes in beams and slabs. The wall is also assigned with 1/10th of stiffness of C−25 concrete and divided in to smaller element and joined with beams. This implies an HCB of class A or B should be used, Class A is preferred. Equivalent stiffness is taken due to pre−cast beam in the 3D modelling so that they transfer the lateral and vertical load to columns and beams respectively.

For the foundation analysis mat and footing are commonly used depending on type of soil condition and building type. In the case of mat foundation the mat is modeled together with the super structure and the TABLE−1: typical mat slab design chart spring constant is assigned depending on the type of the soil. This coefficient is taken from soil test result and literature. After the analysis is made moment reading is taken from the SAP result and design will be made using Excel program shown in Table−1. In the case of isolated footing foundation, fixed support is assumed, totally restrained condition is chosen and assigned at the base of column. After the analysis is made reactions are taken and footing design can be done with any suitable footing design program.

SAP models of the "Addis", "Mekelle A" and "Addis Apartments" housing types are also shown together with structural drawings on the following pages.

MAT SLAB REINFORCEMENT

b	d	M	N	B	As	dia.	C/C Spacing	As provided
(m)	*(m)*	*(KNm)*	*M/Fcd*b*d^2*	*1−(1−2N)^.5*	*B*Fcd*b*d/Fyd*	*(mm)*		
1	0.13	60	0.265	0.314	1574	14	106	Dia. 14/100
1	0.13	50	0.221	0.253	1265	14	132	Dia. 14/130
1	0.13	40	0.177	0.196	980	12	125	Dia. 12/125
1	0.13	30	0.132	0.143	714	12	172	Dia. 12/170
1	0.13	20	0.088	0.093	464	10	184	Dia. 10/180
1	0.13	15	0.066	0.069	343	8	159	Dia. 8/160

1	0.13	10	0.044	0.045	226	8	242	Dia. 8/230

TABLE–1: typical mat slab design chart

Summary

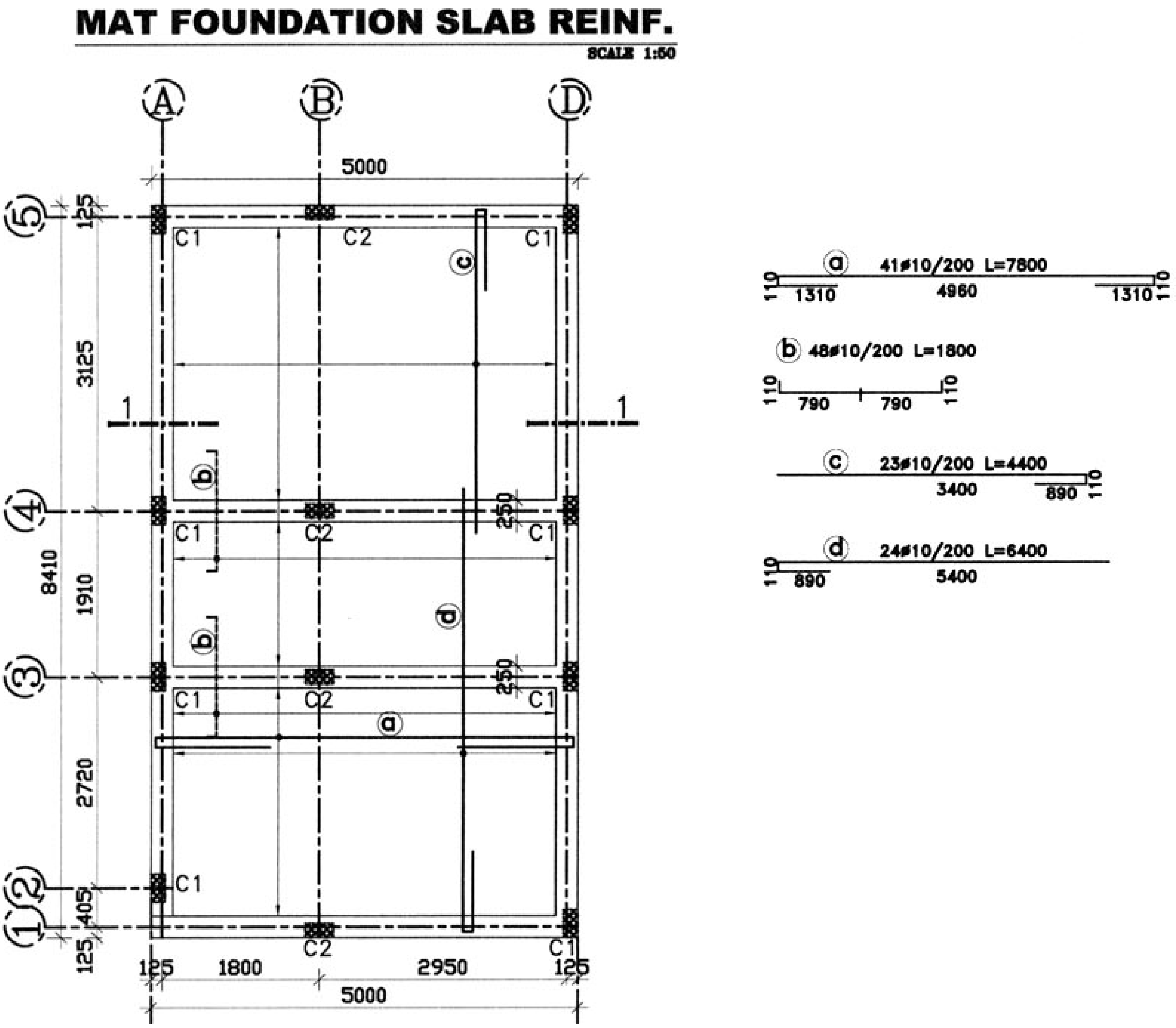
All in all purpose of the design is to make a safe and economical structure that meets it's intended purpose.

The design of the buildings meets the standard code of practice of the country. It is fast, economical and very little formwork is required.

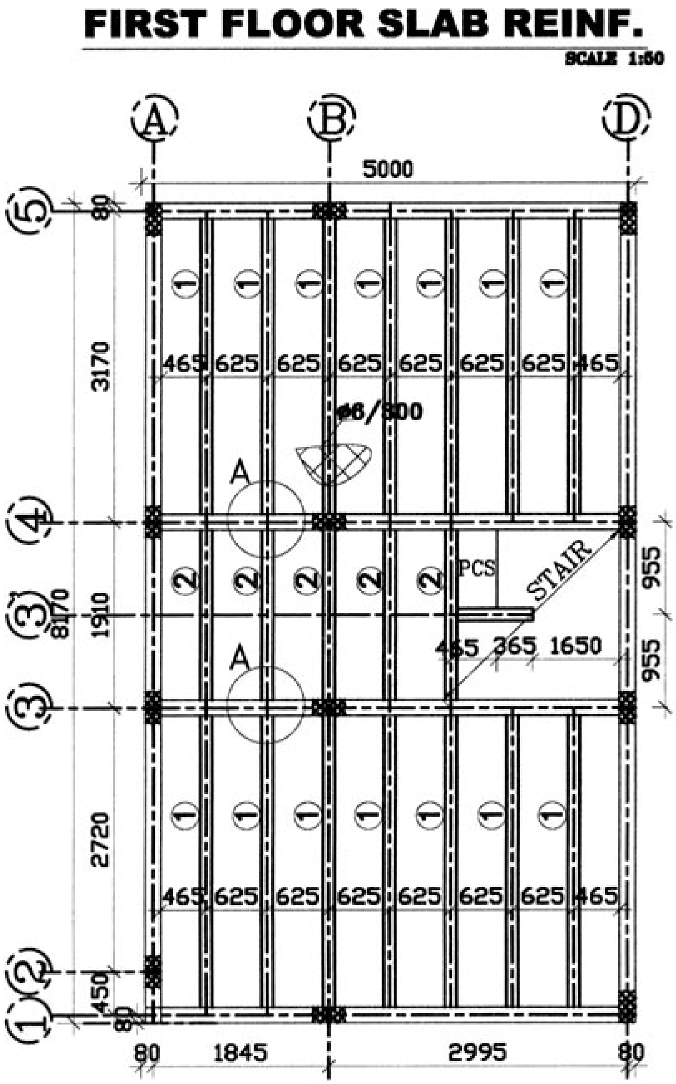
Sample structural drawings for Addis housing type

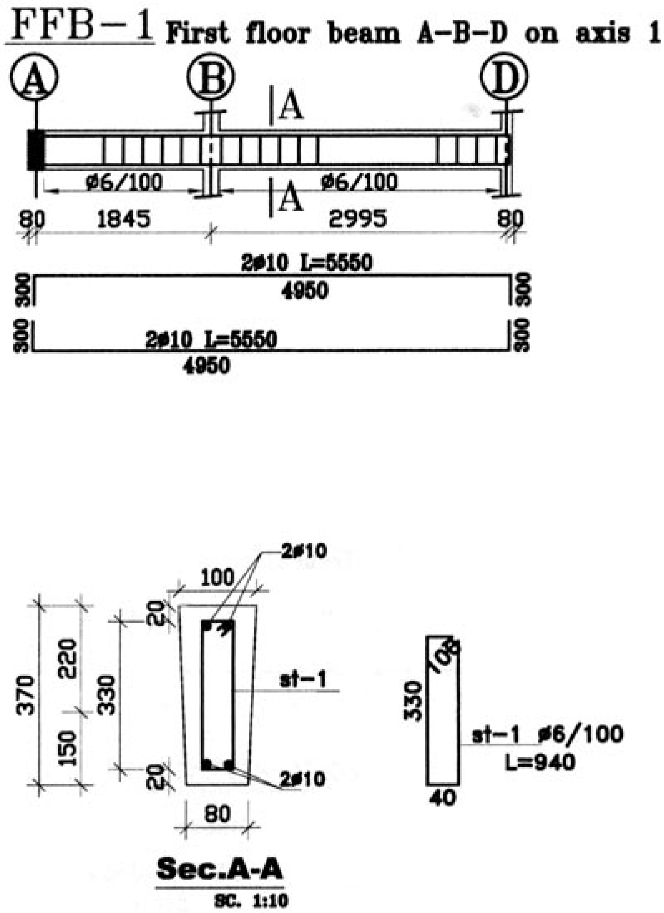
(Alert Site)

<u>MAT FOUNDATION SLAB REINF.</u>

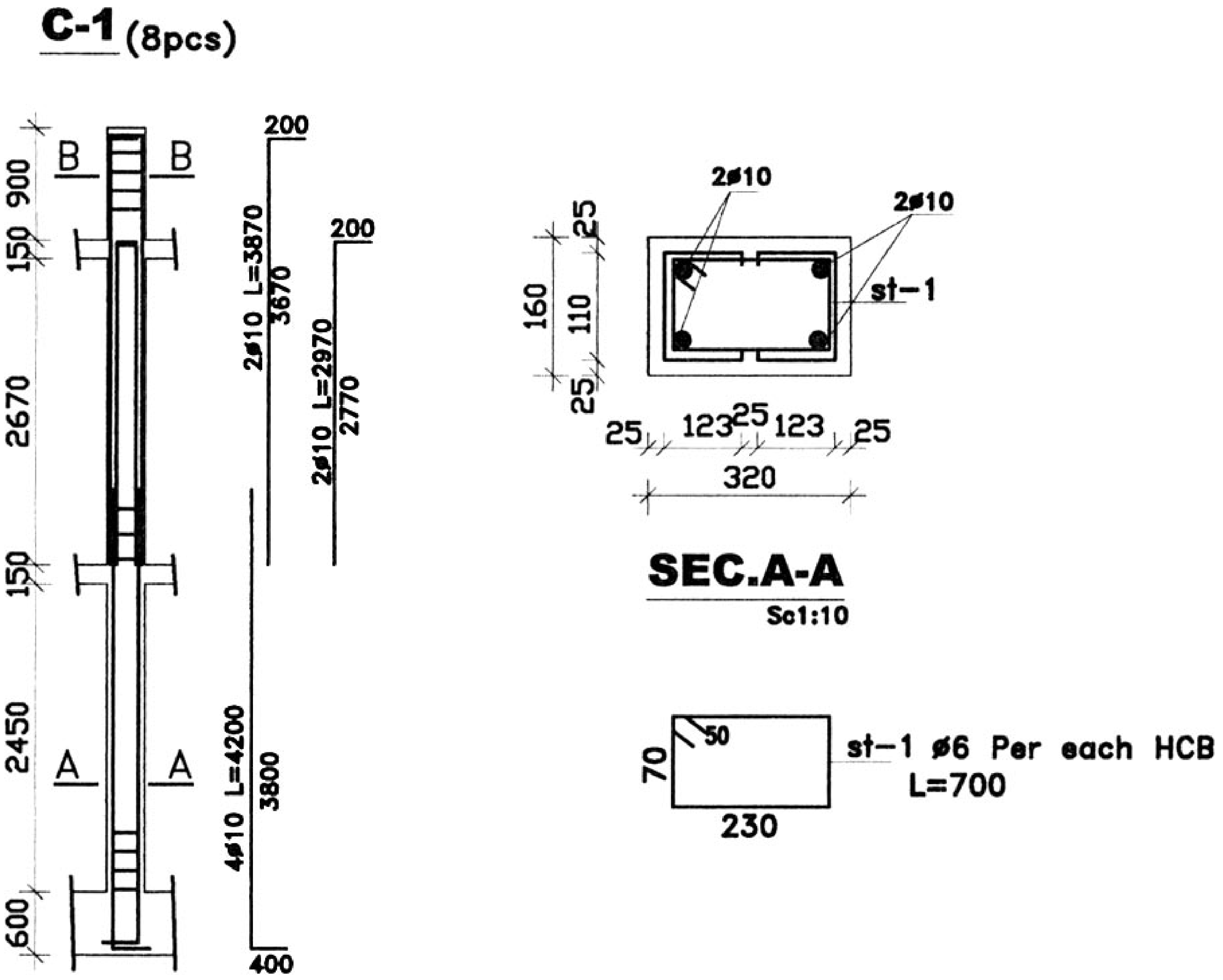


<u>FIRST FLOOR SLAB REINF.</u>

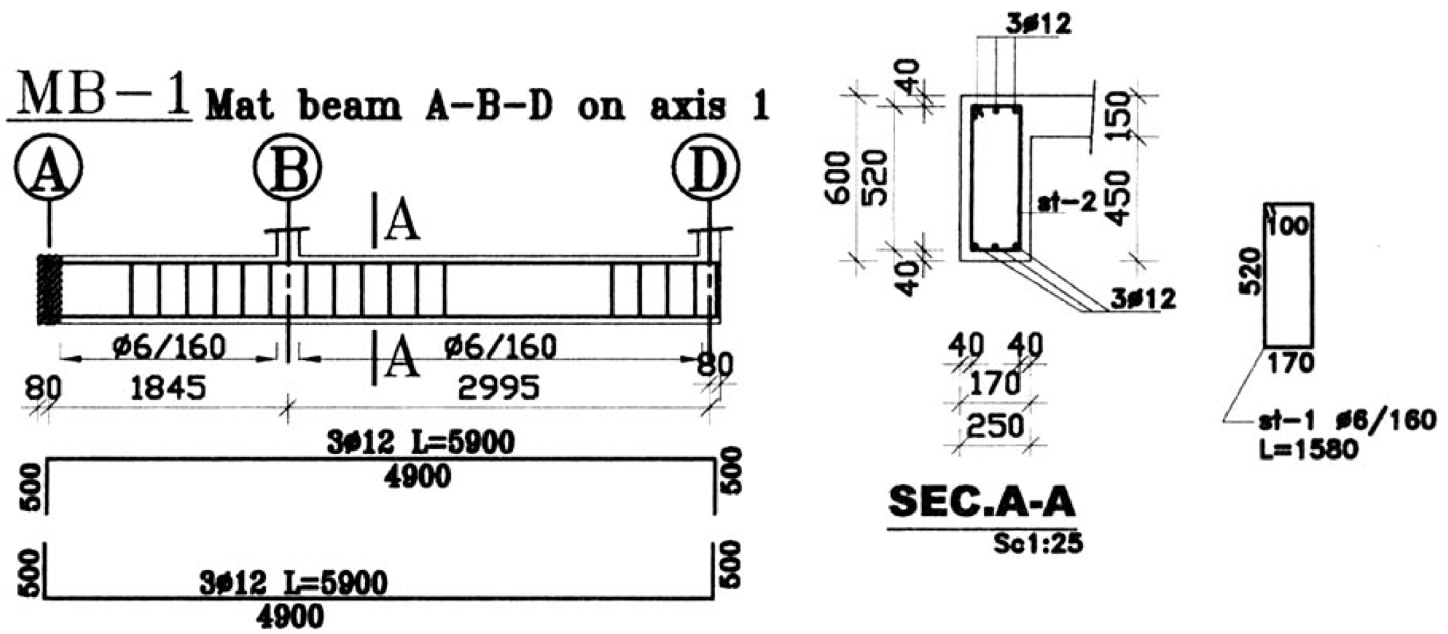

FIRST FLOOR SLAB REINF.
SCALE 1:50
5000
3170
1910
2720
450
8170
955
465 625 625 625 625 625 625 465
ø6/300
PCS
STAIR
465 365 1650
80 1845 2995 80


FFB-1 First floor beam A-B-D on axis 1
ø6/100
ø6/100
80 1845 2995 80
2ø10 L=5550
4950
2ø10 L=5550
4950
100
2ø10
370
220
150
330
20
20
st-1
2ø10
80
Sec.A-A
SC. 1:10
330
st-1 ø6/100
L=940
40

COLUMNS



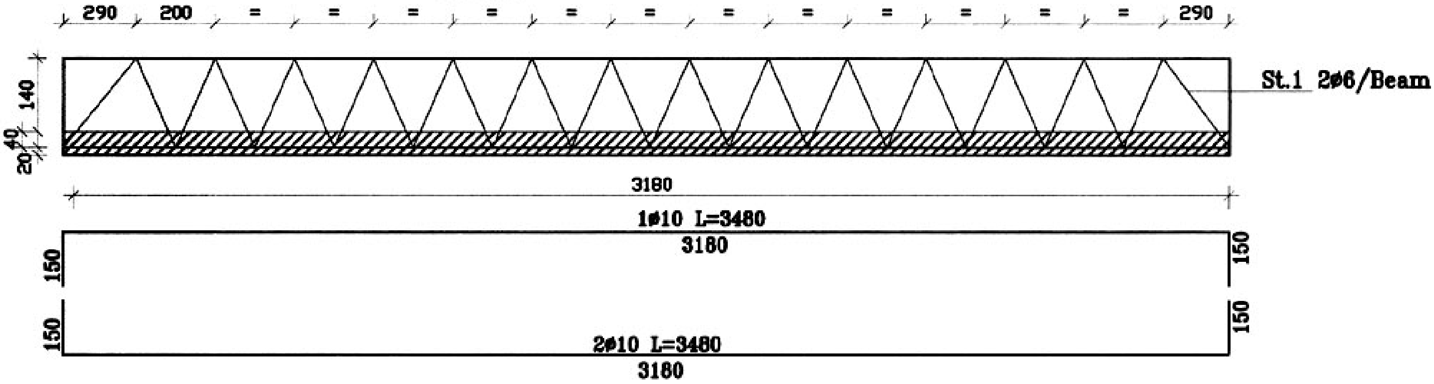
MAT BEAMS



PRECAST BEAM DETAIL

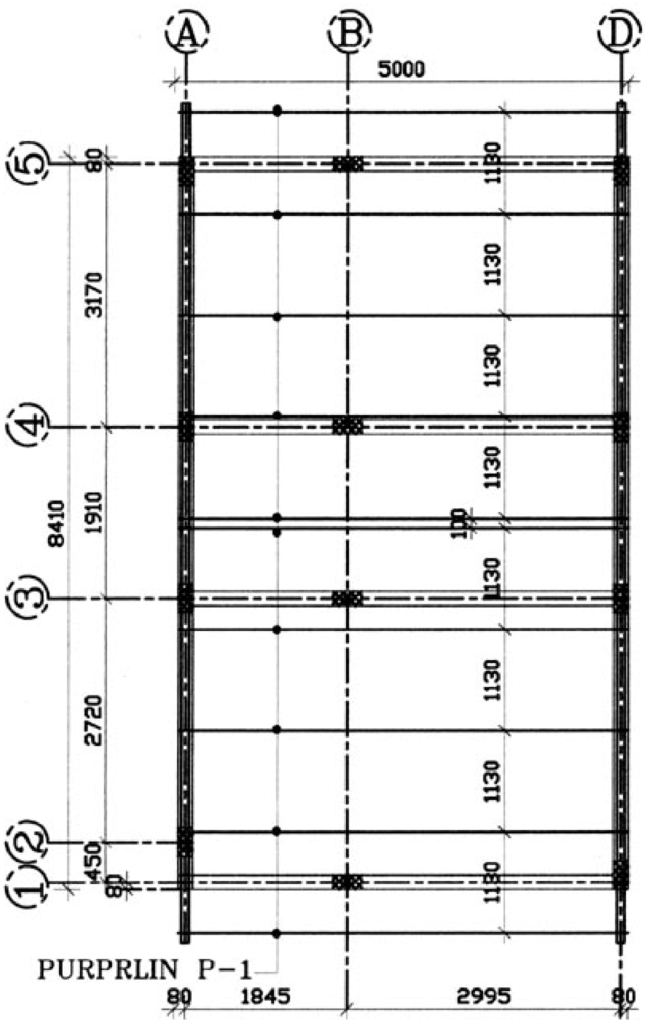
PRECAST BEAM -1 (1694pcs)

SCALE 1:10

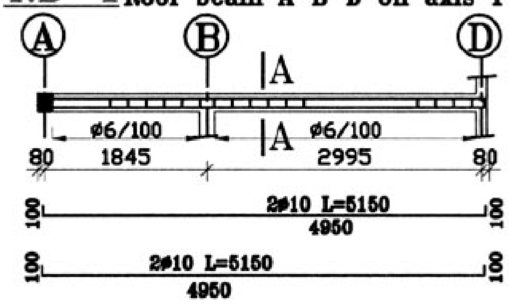


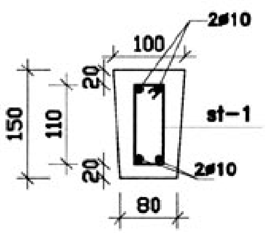
ROOF TRUSS LAYOUT

SCALE 1:50



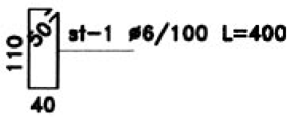
RB-1 Roof beam A-B-D on axis 1



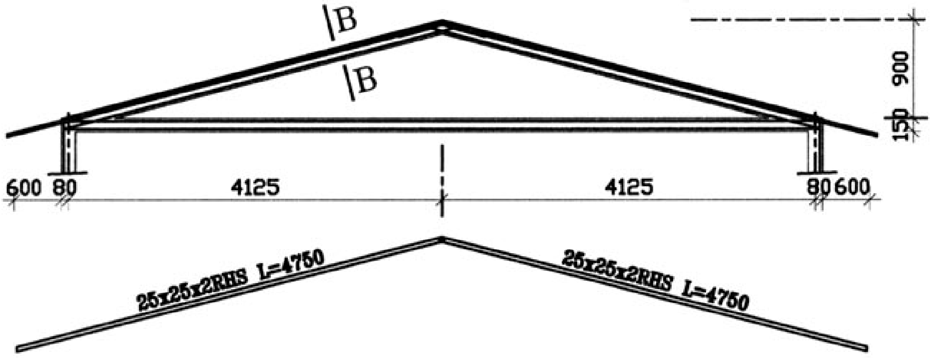


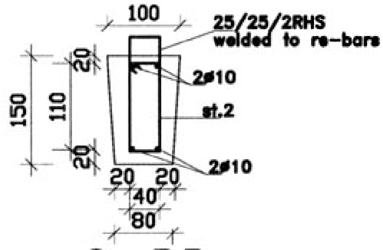
Sec.A-A

SC. 1:25

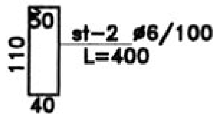


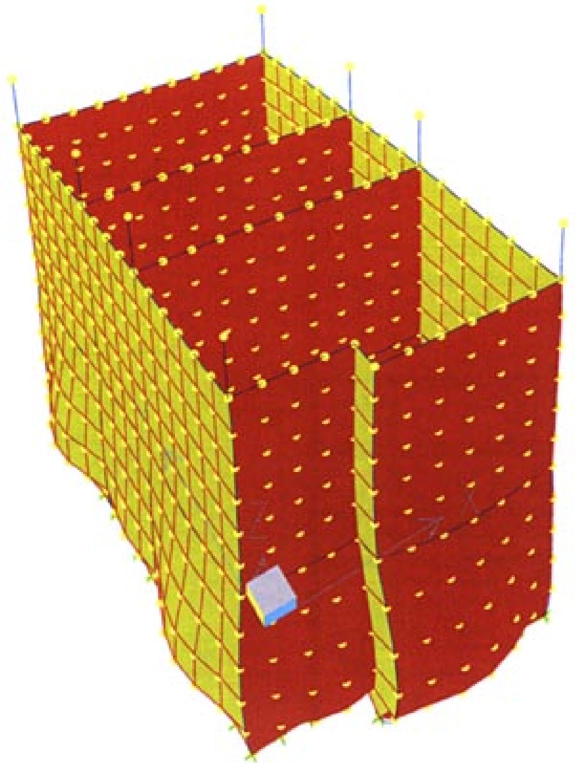
TB−1



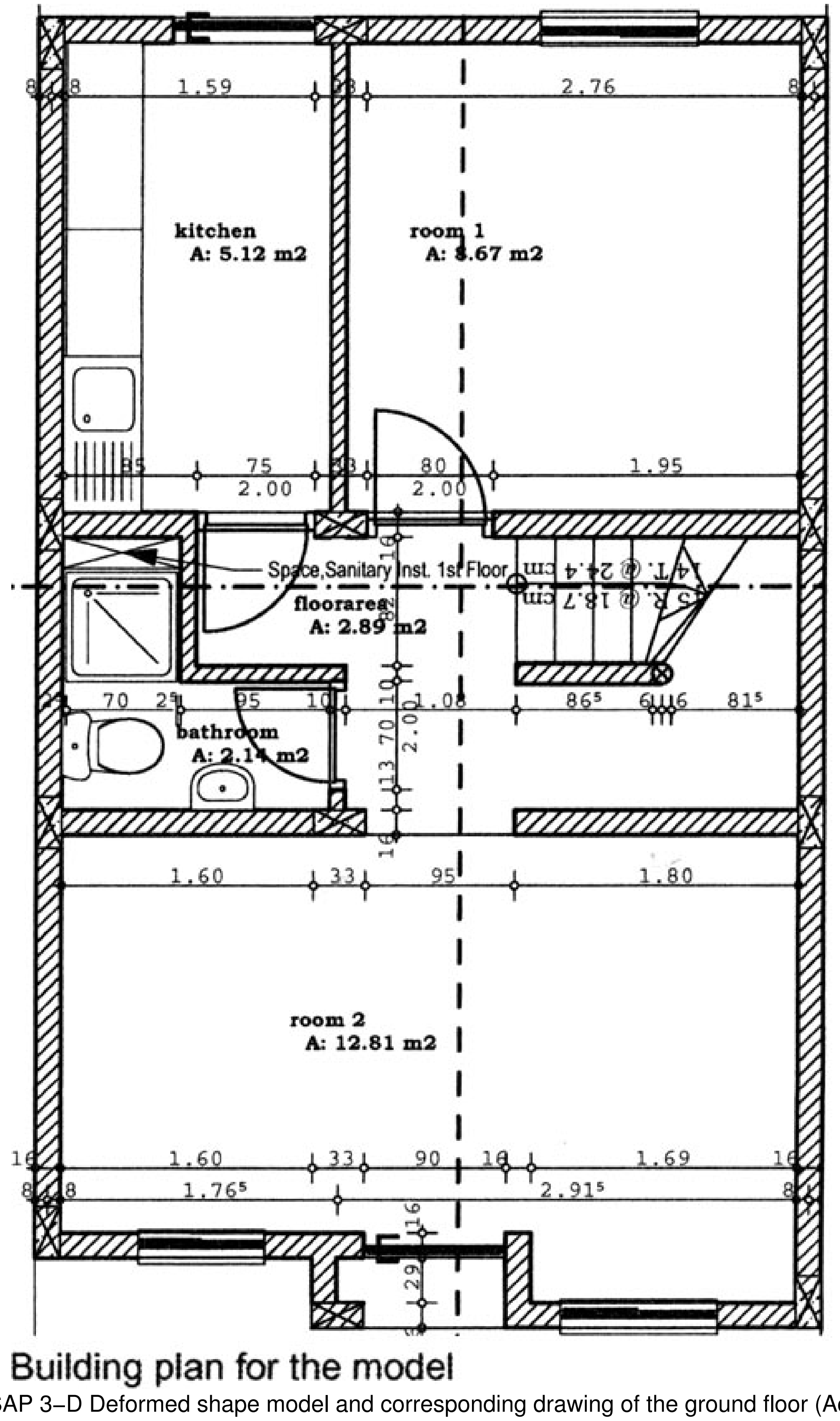


Sec.B-B
SC. 1:25





SAP 2000 model, deformed shape of the 3D model

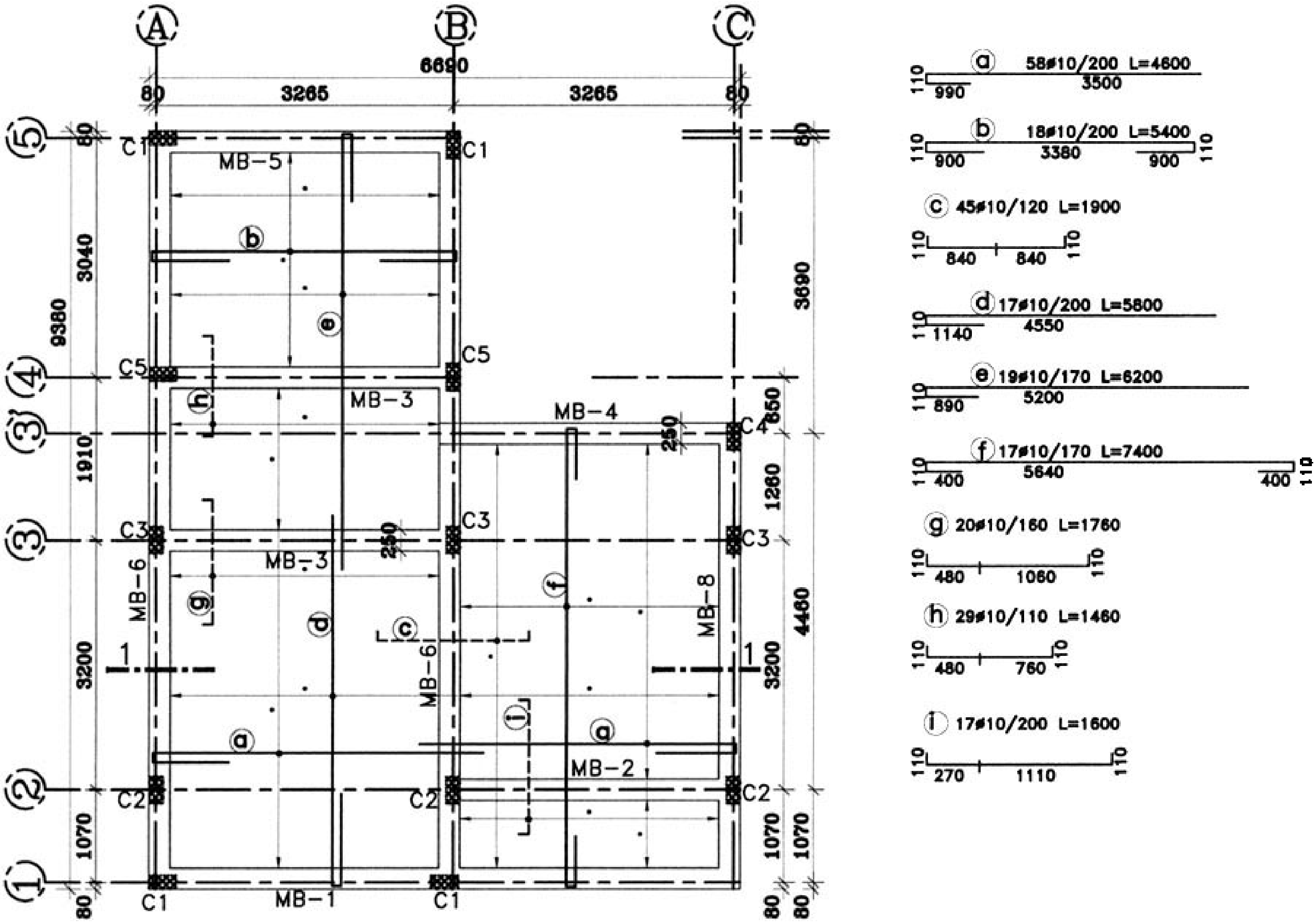


FIG−8s SAP 3−D Deformed shape model and corresponding drawing of the ground floor (Addis Type)

Sample structural drawings for the Mekelle "A" housing type

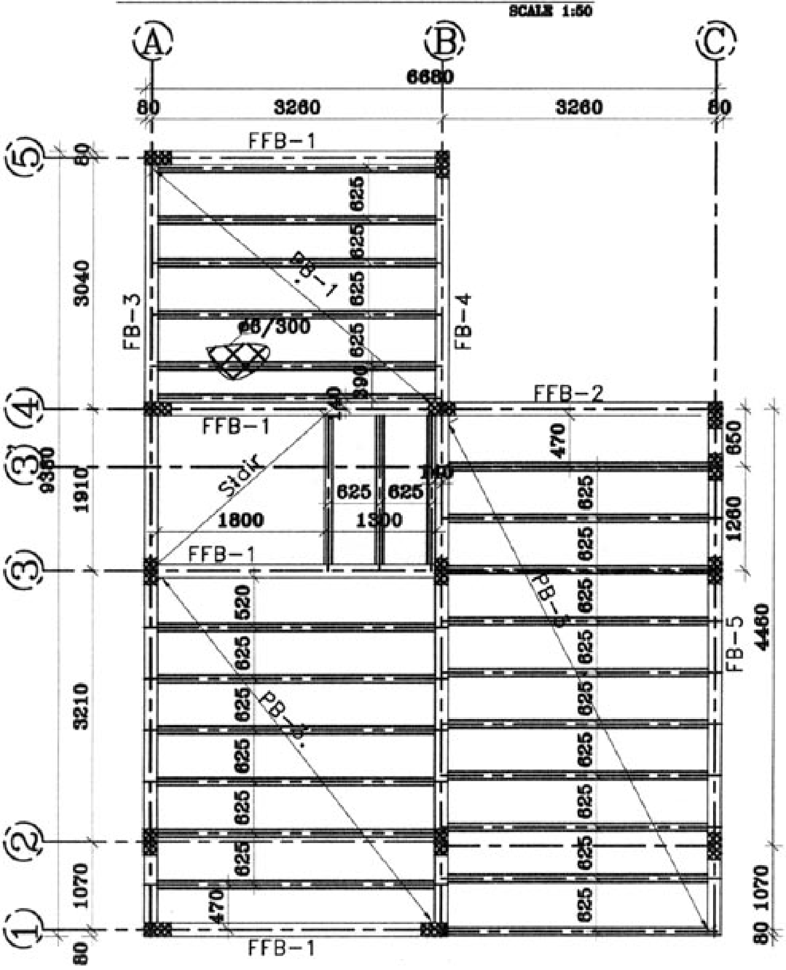
MAT SLAB REINF.

SCALE 1:50

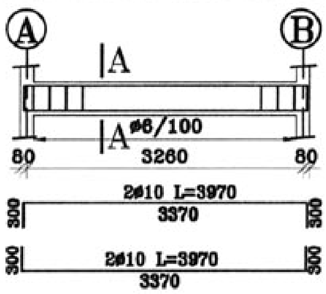


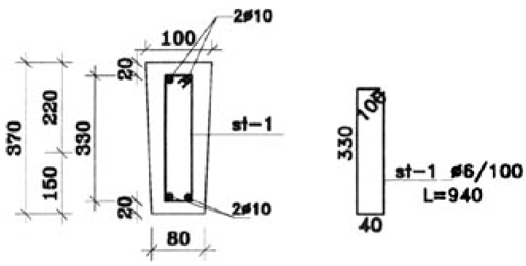
FIRST FLOOR SLAB REINF.

SCALE 1:50



FFB-1 First floor beam A-B on axis 1,3,4 & 5



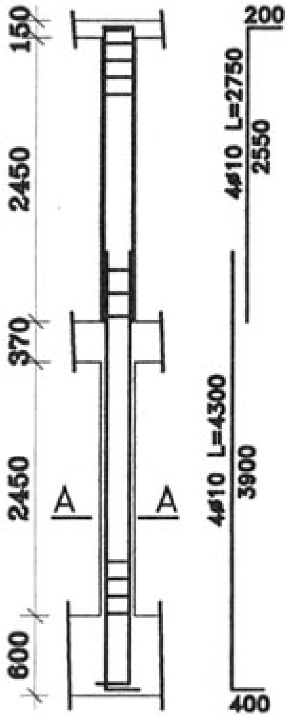


Sec.A-A

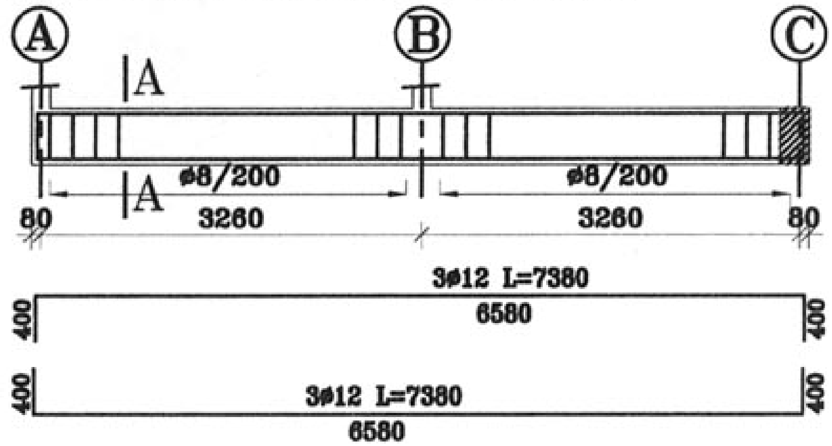
SC. 1:10

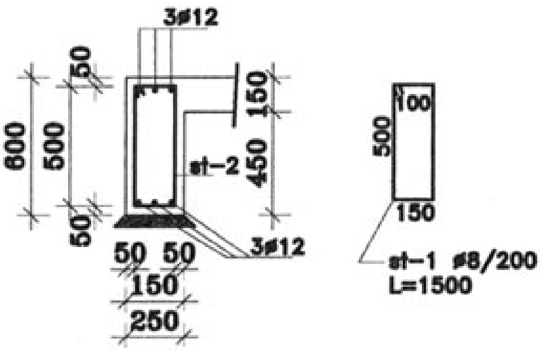
MAT BEAMS

C-1 (4pcs)



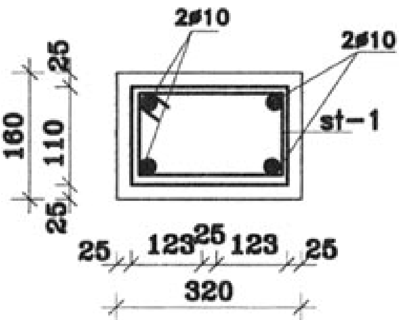
MB-1 Mat beam A-B-C on axis 1





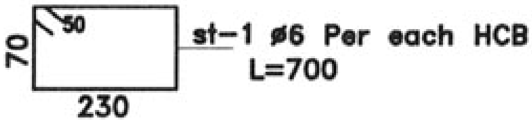
SEC.A-A

Sc1:25



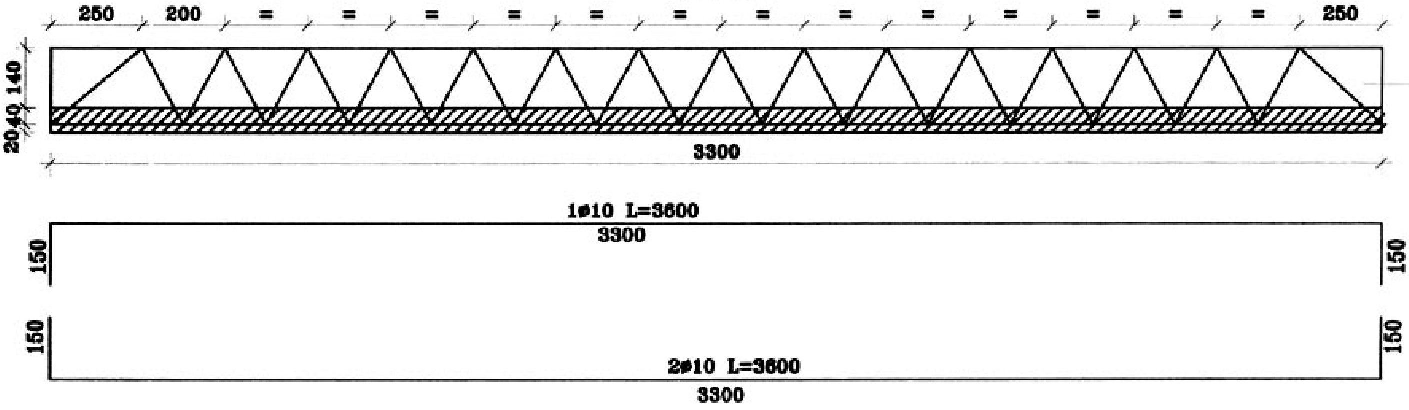
SEC.A-A

Sc1:10



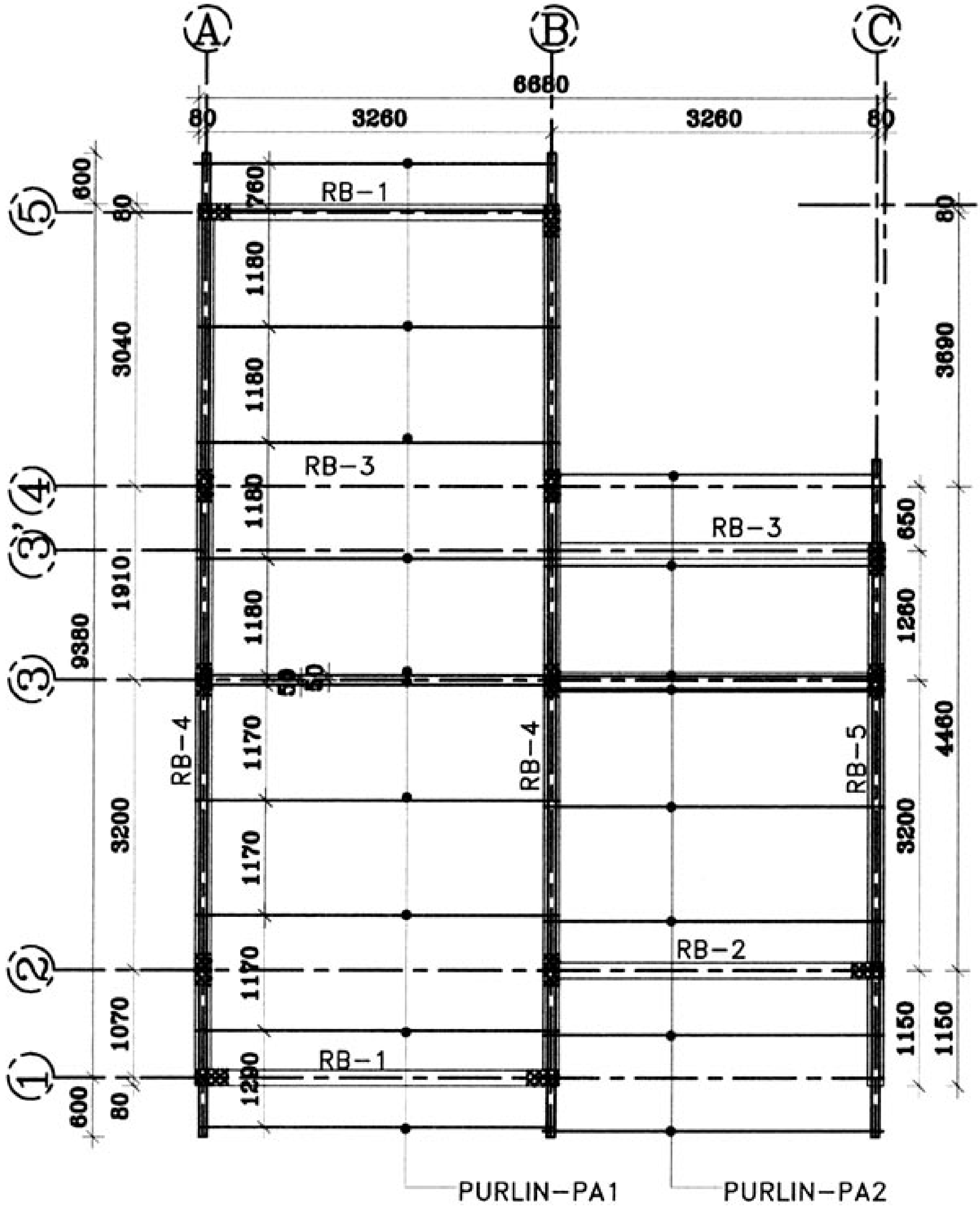
PRECAST BEAM -1

SCALE 1:10



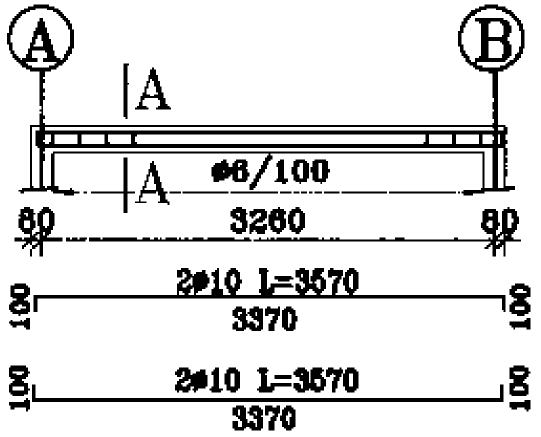
ROOF TRUSS AND PURLIN LAYOUT

SCALE 1:50

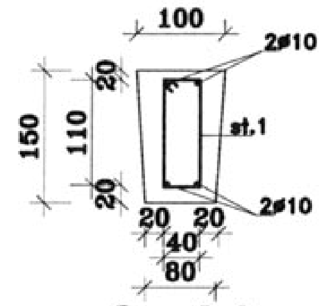


ROOF BEAMS

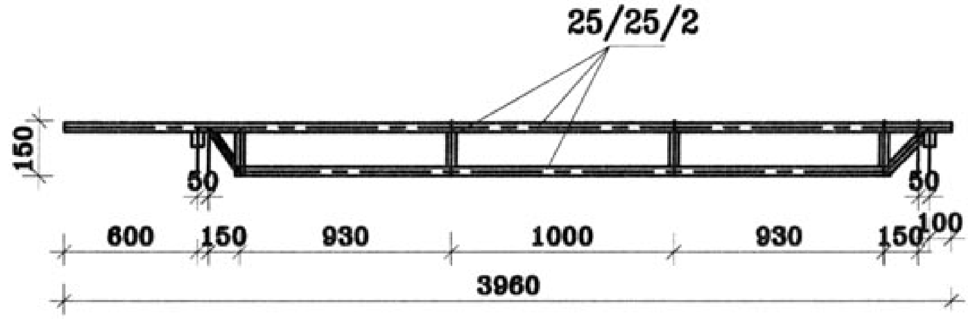
RB-1 Roof beam A-B on axes 1 & 5 at level +5.42

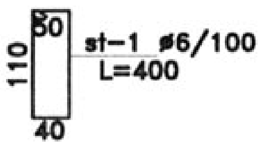


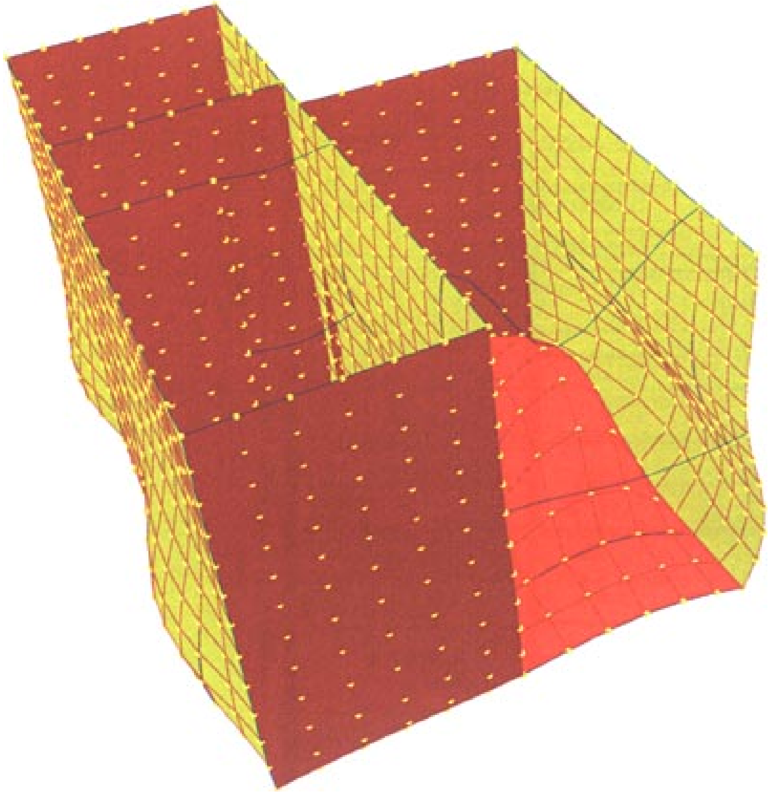
PURLIN-PA1 Lattice purlin (11pcs)



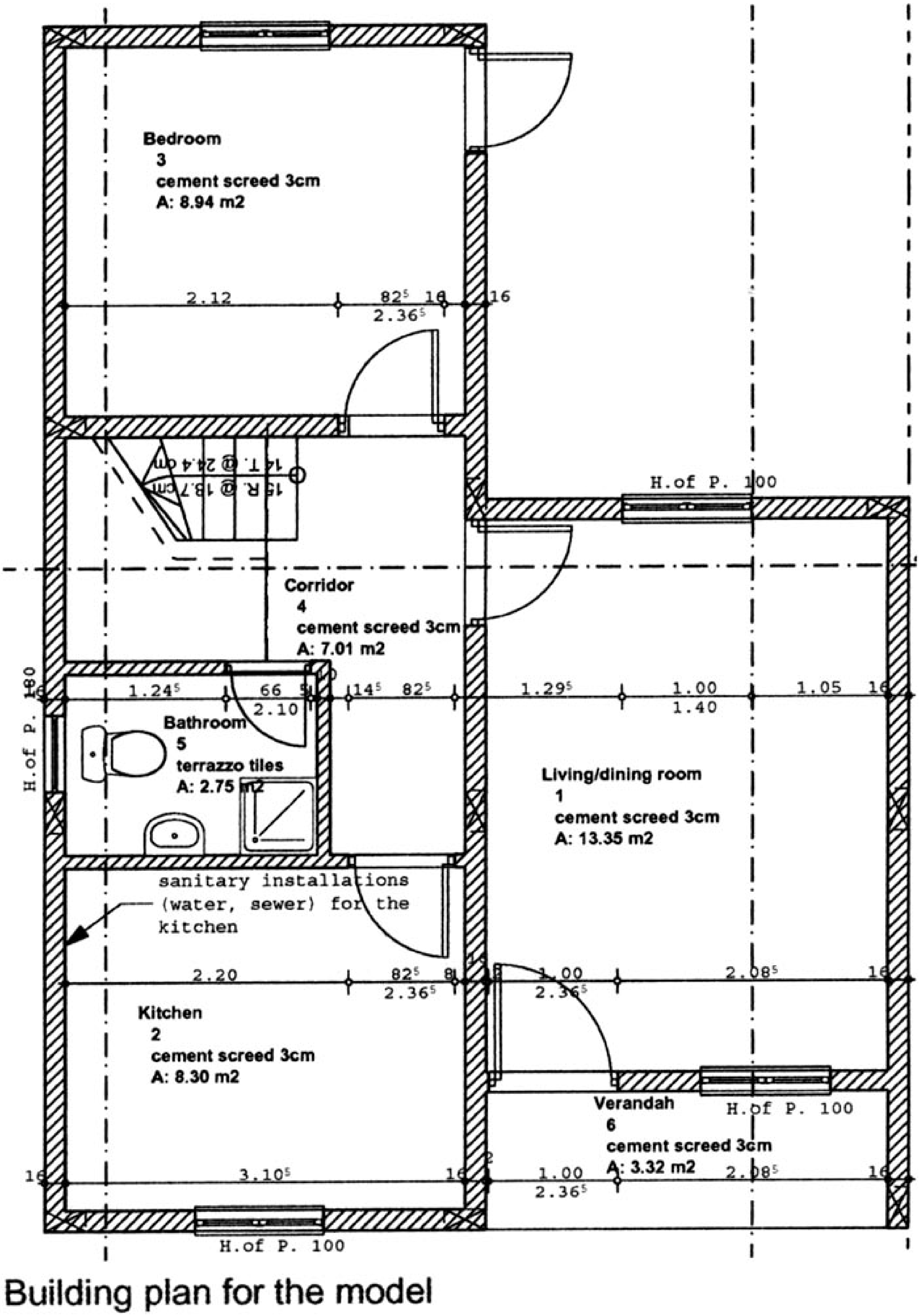
Sec.A-A
SC. 1:25



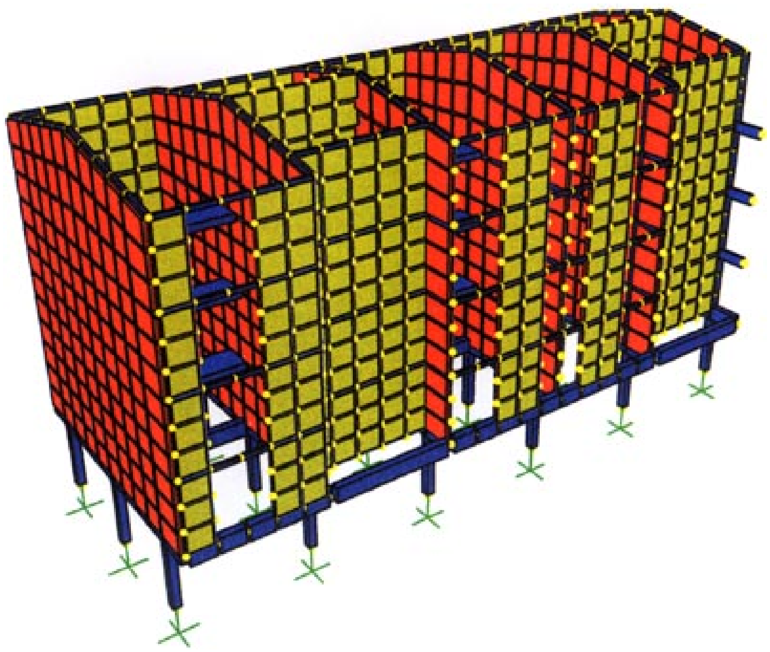




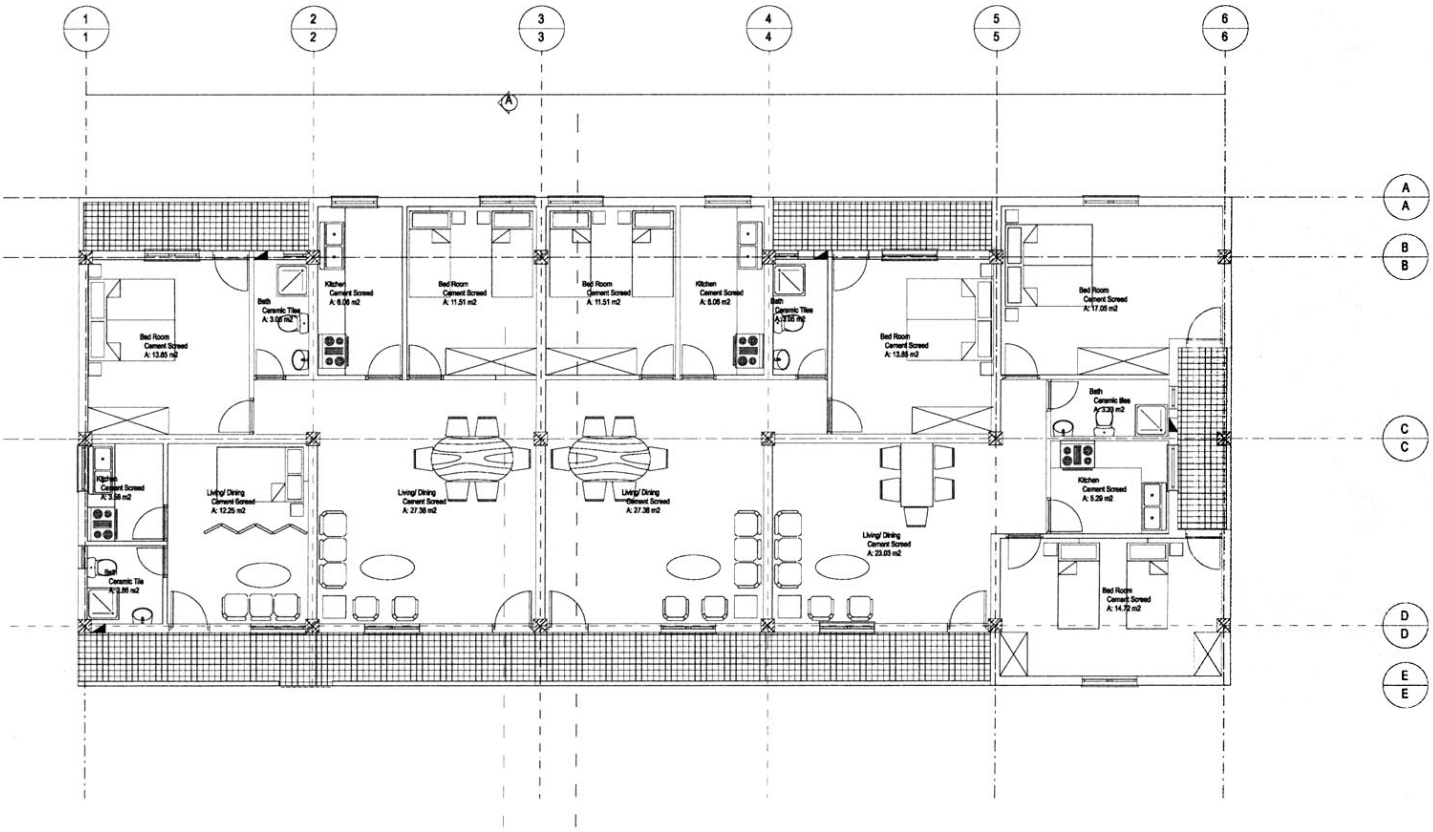
SAP 2000 model, deformed shape of the 3D model



FIG−9s SAP 3−D deformed shape model and corresponding drawing of the ground floor (Mekelle)



SAP 2000 model, deformed shape of the 3D model



Building plan for the model

FIG−10s SAP 3−D deformed shape model and corresponding drawing of the ground floor (Addis Apartments)

NOTES

Back Cover

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Ethio-German TVET Programme

Small Project's Training Manual – Volume III: Sanitation

Table of Contents

Small Project's Training Manual − Volume III: Sanitation

Sudan Council of Churches * Munuki Water and Sanitation Project

by
Marta and Rudi Guóth−Gumberger
1987

0. Introduction

0.2. Foreword

Two people are named as authors of this training manual; however, in reality it is the result of the work of very many people. We hope that it will serve a great number of people as well.

The development of the manual has a long history. We had the opportunity to work with the Sudan Council of Churches from 1982 to 1987, first in the Integrated Rural Development Programme in Yirol, and then in the Munuki Water and Sanitation Project in Juba, both in Southern Sudan. We had been assigned as Water Supply Coordinator (Marta) and Community Development Coordinator (Rudi). In the beginning we had background knowledge but little field experience. So we started to learn with and from the people and from the literature. At the same time we started training the people with whom we worked. In the beginning the training was exclusively on site. However, in the second project, the training became more formalised into a full two years programme of both class and field work. We began from the actual level of knowledge of the trainees without the assumption that "one should know this or that", and gathered whatever knowledge was necessary to do the project work together. Soon, compiling and distributing of written material became necessary, and so this manual was begun.

It includes many of our experiences in the water and sanitation work during the last five years. The bulk of the information was ready in first draft in April 1987. Photocopies were distributed to the participants of a three months training course. Contributions and questions from the participants were invaluable, and many sections were revised/improved. Actually, the manual would have never been written without the eagerness of the Munuki project's staff to learn. This interest made learning and teaching very enjoyable. After the training course, the entire manual was revised further and finally completed to the present version.

We thank our colleagues in the Munuki Water and Sanitation Project for all we learned from them, for their good cooperation and for their contributions to the manual. They are: Edward Lako, Arthur A. Columbano

Lado, Rhoda Benjamin, Joseph Lado Lubajo, Joan Batul Eliaba, Simon John Lubang, Gloria Habakuk Soro, Paulino Onorato Legge, Prissy M. Wai Wai, Jackson Onan. We also thank the course participants from Swedish Free Mission and Sudanaid for their contributions. They are: Inga Andersson, Margaret Toya, Isaac Kajokole Kenyi, James Jamil, James Wani, Lona Kojo Michael, Julius Sebit, Erasto Tupa, George Mogga Wani, Elijah Biar, Rose Paul, Robert Otik, Rhoda Yangi Wesley, Quintino Pitya, Anna Itto Njimirano, Ben Juma.

We extend our thanks also to Tom Benton, Sr. Margaret Donohue RSM, Paul McGleenan, Paul Hiebert, Char Holcomb, Stephen Power SJ, Dr. Douglas Reitsma, Susan Sunflower, Dr. Ruth Goehle, Betsy Bascom, for the tiresome work of proofreading.

We thank Mike Gogonya, Hakim Benjamin and Stephen Hakim for many of the drawings.

We are also very grateful to Michael Kubrom Habtai who shared his office with us during the weeks of final revision and typing, made the SCC library available for us and encouraged us with practical help and supporting words.

We thank the Sudan Council of Churches, and especially the Deputy General Secretary, Kosti Manibe, for the generous support which made this manual possible, by providing working facilities, financial resources, an electronic typewriter and numerous other resources.

There are many other individuals whom we would like to thank for their helpful contributions, but who are too numerous to be named.

We apologise for mistakes which remain in the manual in spite of revisions and corrections, and kindly ask the readers to send any corrections, comments and suggestions about the manual to one of the following two addresses:

Márta Guóth−Gumberger, Rudolf Gumberger
Neue Heimat 5a
D−83024 Rosenheim
Germany
Tel.: 08031/81103
Fax: 08031/43695

Munuki Water and Sanitation Project
Sudan Council of Churches
P.O. Box 469
Khartoum
Sudan

For further copies of the manual please contact:

Publicity Office
Sudan Council of Churches
P.O. Box 469
Khartoum
Sudan

As this work would never have been possible by our own strength without God's help, so we hope that God will also protect and strengthen any persons who use this manual and any future work done with the help of this manual.

Khartoum, 11.11.1987
Márta and Rudi Guóth−Gumberger

0.3. Purpose Of The Manual

The following introduction should help the reader to orientate her/himself to the manual and make best use of it.

According to the title, this manual is intended for small development projects with 20 to 40 staff members. The administrative and organisational structures described correspond to this project size.

Secondly, this book is a training manual. It does not intend to present all the information available for professionals about a covered topic, but rather to select the most basic and relevant information about a topic. Then it arranges and presents it in such a way as to introduce a beginner, but also that a trained staff can find it helpful. The manual will help senior staff to organise and improve their management.

The aim of this manual is to train senior secondary school leavers to become skilled technicians in water supply and sanitation work, to run a store, to keep records and do qualified field work, or to become community development officers. They should be able to lead a team later on and to do basic work in administration.

However, the manual can serve different purposes as described below:

1. Training:

   – It can be used by the trainee for self–study or as complementary material to the teaching in class.

   – It can be used by the teacher/instructor as a guideline for preparing lessons in class about the covered topics.

   – Some parts can be used as guideline for technical training for illiterate people.

   – Some parts can be used as guideline for training sessions in the community.

2. Guideline:

   – It can be used by experienced people as a help to develop and build up a new small project.

3. Reference book:

   – It can be used as reference in day–to–day project work in the different covered fields.

   – It can be used by the trainee for looking up particular information after the course.

   – It can be used for revising previously acquired knowledge.

0.4. Possible Readers of the Manual

The manual provides material for a two years training course for several (technical) areas with 25% training in class and 75% training in the field. It is expected that not everything in the manual is for every trainee or reader.

The manual was developed in a water and sanitation project. Therefore, major parts deal with these subjects. However, many parts are of a more general nature so that they might be useful for staff of other projects, for churches, communities and development organisations.

In detail, material from the manual might be useful for the following groups of staff:

No	Staff or Trainees	Relevant Sections	Relevant Chapters
1	senior staff in management functions	1,2,3,7	4.18; 4.21; 5.1; 5.2;8.11 8.29; 9.8
2	administrative staff, typist	1,2	5.1; 5.2; 5.8
3	bookkeeper	1,5	2.9–18; 3.3–4; 7.2–12
4	community development staff	1,4,9	2.7; 2.11–12; 2.18; 3.1; 3.2; 3.11–13; 5.1–2; 5.8 7.1; 7.6; 8.1–11; 8.29; 8.33; 8.36–39
5	water supply staff	1,5,6,7,8,9	2.11–15; 2.18; 3,1–2; 3.11–13; 4,1–2; 4,15–16;
6	other technical staff like building staff	1,3,5,6,7	
7	storekeeper	1,5,6,7	8.32
8	logistics staff	1,3,5,7	2.18; 6,3–5
9	driver	1,3,5	2.18; 6,3–5; 7.6

0.5. Summary of the Contents

The manual consists of nine sections, compiled in three volumes:

Volume I	1. General Knowledge
ADMINISTRATION	2. Administration
and	3. Running a Vehicle
COMMUNITY DEVELOPMENT	4. Community Development
Volume II	5. Mathematics
WATER SUPPLY	6. Basic Technical Knowledge
	7. Building Administration
	8. Water Supply
Volume III	9. Sanitation
SANITATION	

Volume I contains the general parts combined with community development, volume II and III contain the technical parts.

The manual was divided into three volumes so that it can be used in parts and become more handy for the reader– Sanitation was taken as a separate volume, because many may be interested in this section alone. Still, the manual is one work and the different sections belong together. There are many references pointing to other chapters in a different volume.

The different sections are briefly introduced in the following:

1. General Knowledge

Relevant information not fitting into the other sections was compiled here. "Using a Dictionary", "Reading Techniques" and "Study Techniques" are useful for the work with the manual. "Private Budgeting", "First Aid" and "Applications" are also generally needed knowledge.

2. Administration

The basic administrative knowledge and procedures for a small project of 20 to 40 staff members are compiled here.

3. Running a Vehicle

Here everything which a responsible user of a vehicle − not a mechanic! − has to know in order to run the vehicle economically and to prevent unnecessary damages is compiled. The section is important for both senior staff or logistics staff and drivers.

4. Community Development

This section compiles basic information necessary for community development work, both of general nature and background information as well as practical procedures.

5. Mathematics

The manual is not intended to be a mathematics book. Therefore, you cannot find detailed explanations of mathematical principles. Rather you will find a collection of mathematical knowledge in recipe−style about whatever was found necessary for the project work − mostly very simple things and few more sophisticated.

6. Basic Technical Knowledge

Basic technical knowledge for the water supply and sanitation work is compiled here, "Basic Technical Drawing", "Using Measuring Tools", "Tools", and "Cement and Concrete" being the most important ones to be studied first.

7. Building Administration

The specific administration necessary for construction work is described her, consisting of "Planning", "Record Keeping", "Cost Calculation", "Purchasing" and "Storekeeping".

8. Water Supply

The section about water supply starts with general knowledge about water, discusses the different well types, the selection of a well site. Construction of hand dug wells with concrete rings is described in detail. An overview about pump types is given; some of them are described in more detail, especially hand pumps, and basic plumbing is added. "Well Disinfection", "Water Treatment" and "Health Education" are discussed in the end.

Hand dug wells and hand pumps were deliberately selected as main topics to be covered. Other books (see bibliography No. 17, 18,35) cover these topics much more comprehensively; however, here the emphasis was to prepare training material in easily understood overviews and step−by−step procedures.

9. Sanitation

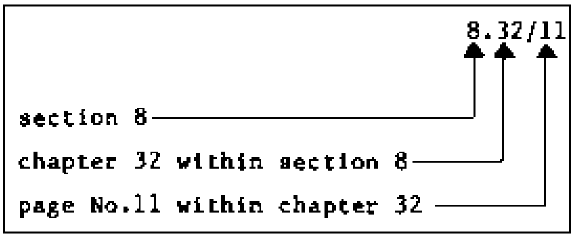
This section starts with general background knowledge about sanitation. The different types of disposal systems are introduced and guidelines for selecting the suitable latrine suggested. Deliberately, only sanitation systems without water were selected to be covered. Several are described in more detail. The main emphasis lies on compost latrines, including different designs, composting process, construction, operation and maintenance, and follow−up. Chapters about children's squatting slab, bath, waste matter and pesticides complete the section. Many parts of this section are suitable for training sessions about sanitation in the community or in schools.

0.6. Format and style of the Manual

As the purpose of the manual is to assist trainees, teachers and field staff, we put emphasis on giving it a consistent and easily understandable format. The colleagues in the project work found that providing structures was helpful, and they had no difficulties at all filling the structures with life and flesh. Therefore, the manual offers a lot of structures, forms, tables, boxes, and step−by−step procedures. This shall help to gain an overview about the field and to easily find the required information.

A) <u>Format of the Manual</u>

The page numbers on top of each page reflect the format of the manual. Each one of the nine main sections contains several chapters. Each chapter has one or more pages.



The introduction with foreword, etc., is added as another section 0. The appendix with bibliography, index, etc., is added as section 10. Section 0 and 10 are attached to all three volumes to help the reader use the manual. Thus, the volumes contain these sections:

Volume **I**: sections 0, **1, 2, 3, 4,** 10
Volume **II**: sections 0, **5, 6, 7, 8,** 10
Volume **III**: sections 0, **9,** 10

Consecutive page numbers at the bottom of each page run in each volume separately.

Each chapter starts on a new page. Both the title of the section and the chapter are named:

8. Water Supply

8.14. **Basic Plumbing**

Directly under this headline you will find one or several bible quotations in some chapters. These were used for the prayer fellowships which were an integrated part of the three months course, and are related to the topic where they are mentioned.

Usually, each chapter starts with a brief introduction as each chapter is an entity by itself and should be readable by itself. The material within one chapter is mostly structured according to the same system, for example, in the lesson "Basic Plumbing":

A) <u>Threads</u>

1. <u>Thread Types</u>

    a) Internal/External Threads
    b) Right Hand/Left Hand Threads
    c)..........
    d).........
    e).........
    f).........

2. <u>Thread Standards for Bolts and Nuts</u>

    a) Metric Coarse Threads M
    b).........
    c).........

3. Thread Standards for Pipes

a).........
b).........

4. Pipe Measurements

B) Basic Operations of Plumbing

1. Cutting with a Hacksaw
2. Pipe Cutting
3..........

C) Pipe Joints

1..........
2..........
....

Most lessons have only a structure A, B, C,... and 1., 2., 3.,... All titles are capitalised and underlined, as well as other important words within the text. All important messages are put into boxes. Step–by–step procedures are either numbered or put into a box with a separate column giving the reasons. All tables are in boxes.

As each chapter is a separate entity and can be used as a teaching unit, a continuous flow between the chapters is not maintained. Repetitions occur sometimes, otherwise, a reference refers to the relevant chapter containing more information about a certain point.

B) Language of the Manual

The manual deliberately uses simple English to explain a topic, to give trainees with limited English knowledge a chance. Simple sentence constructions were preferred to elegance of style. Some special vocabulary in the different topics was introduced, but always with explanations. Often another equivalent word is given in brackets, e.g.

"serrated (= toothed)",
"aquifer (= water–bearing layer)"

As the book is a training manual, no foot–noting was applied. We used drawings and information from books together with project experience and compiled them for the teaching purpose. The literature used and useful for further readings is compiled in the bibliography.

C) Drawings

Many drawings are added for illustration and easy reading. In the technical part, mostly proper technical drawings are used (such as cross–section, layout plan, etc.), because they convey the information in a more correct and complete way than other types of drawings. The reader/trainee not acquainted with technical drawings must study chapter 6.1 "Basic Technical Drawing" before reading. Experience showed that the trainees without previous technical training were soon able to read technical drawings. The drawings in the manual shall also give the trainee practice in reading technical drawings. Almost all drawings are placed below or beside the relevant text, although this way consumed more space. This shall ease the reading as well.

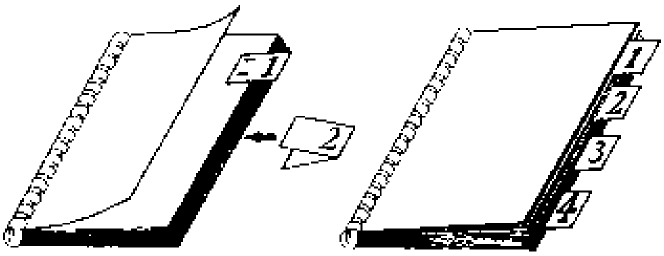
0.7. Instructions on how to Use the Manual

As not everything in the manual is useful for each reader, you need to pick what is interesting for you. Selection should be easy because of the provided structures. The following can help you to make full use of the manual:

1. Do not attempt to read the manual from the first to the last page like a novel.

2. Make yourself acquainted with the format and the paging of the manual (see 0.6).

3. Cut separation taps from carton paper for the different sections and glue and staple them to the title page of each section



4. Use the SQ3R−method explained in 1.3 to read the manual.

5. Read the table of contents and mark which chapters are interesting for you.

6. Decide which chapters to read first. Chapters 1.2, 1.3, 1.4, 5.1, 5.2, provide necessary basics for further reading of the manual; for technical staff also 5.3, 5.4, 6.1.

7. Apply the SQ3R−method for each chapter as well. Read the headlines of the chapter first to get an overview, collect your questions about the material, etc.

8. Underline important key−words; write your notes, remarks and questions into the manual wherever needed.

9. Use the list of abbreviations, list of forms used, list of leaflets and posters, in the end of each volume.

10. Use the index in the end of each volume to quickly find information about a certain point.

11. Use the bibliography for further studies.

0.8. Instructions on how to Teach with the Manual

There are many books about how to teach, and teaching methods are not the topic of this manual. Thus, only a few suggestions are compiled in the following on how to teach with this manual (see also 4.14; 4.24).

A) <u>General Learning Conditions</u>

Help obtain good learning conditions:

1. Take special care that the class becomes a community, that the trainees get to know and respect each other, that they can mutually help each other. Fruitful learning can only take place in an atmosphere of cooperation.

2. Believe that the trainees are capable of learning. Trust is essential for encouragement and learning.

3. Take special care that the physical situation is supportive for learning: an adequate room, water, feeding, sanitation must be available. Involve the trainees by distributing assignments

(fetching water, cleaning, organising food, etc.).

4. Take care that the trainees have sufficient materials like files, paper, pens, etc.

5. Arrange the class in the classroom in a circle whenever possible. This is the case for most of the chapters in this manual, except for the ones involving calculations.

B) Planning Lessons

Good preparation is essential for good teaching:

1. Take time for preparing your lessons. Roughly estimate as much time for preparation as for class time.

2. Plan the syllabus before a training course.

3. Each chapter in this manual is an entity by itself and can be used as guideline for a lesson. Some chapters may take several lessons to cover. Roughly, maximum five pages can be covered in a teaching unit of two hours.

4. Plan extra lessons in the beginning of the course just for explaining the syllabus and the format of the manual.

5. Plan enough time for evaluation.

6. When planning your lessons, mix the teaching methods: mix group−work with class discussions, calculations with explanations on a model, etc.

7. Have your teaching material (models, posters, etc.) ready before the lesson.

C) Teaching Methods in Class

A variety of teaching methods is suitable for teaching with this manual in class:

1. You can structure many lessons according to the SQ3R−method (see 1.3):

S = Survey:	Explain at the beginning what the lesson will cover.
Q = Question:	Ask the trainees if they have questions about the topic and note these down. Check after the lesson if the questions were answered.
R = Read:	Conduct the lesson. Explain the material.
R = Recite:	Let trainees repeat and explain with their own words what they have learnt and understood.
R = Revise:	Give homework, revise the following day or after one week.

2. Use group−work. Let groups of 4 to 5 discuss a certain question, try to read a passage or a drawing of the manual together, collect different aspects of a topic, etc.

3. Use discussion in the whole class to summarize group−work, to introduce something new, to explain an aspect relevant to all.

4. Use from time to time work on a certain assignment for each trainee alone (e.g. calculations).

5. Use role plays whenever possible (e.g first aid, interaction of technicians with the community, etc.). They are fun and very educative.

6. Teach by action whenever possible (e.g. cleaning and rehabilitating a latrine, safety measures, interview, etc.).

7. Include field visits into your training programme.

8. Use posters, models, actual examples, whenever possible. Many of the drawings in the manual can be drawn on big posters for use in class. Well construction work is best understood when demonstrated with small models. Bring pieces of material for everything you discuss in class.

D) Questions

Asking questions is a way to learn, for both the teacher and the trainee.

1. Encourage the trainees to ask questions.

2. Ask at the end of a lesson whether there are any questions.

3. Ask in the beginning of a lesson if questions remain from the day before.

4. If you cannot answer a question, do not pretend and dodge around. Admit it, look it up after the lesson, and answer it the next day.

5. Spend some time before and after the lesson in class to give the trainees a chance to ask.

E) Homework

Study on her/his own is essential for the trainee in order to be able to digest the material learnt.

1. Give homework to almost all of your lessons.

2. Encourage students to keep their homework well filed and organised with chapter numbers and headlines.

3. Ask trainees from time to time to prepare for a lesson on their own by studying the manual in advance.

4. Take time to correct the homework and return it as soon as possible.

F) Teaching Field Work

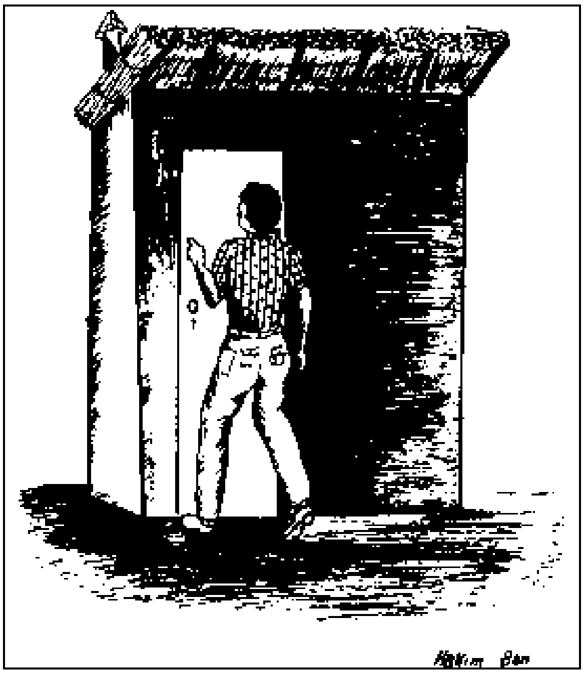
Some extra efforts in teaching field work will improve the results considerably.

1. Before you do a new type of work the first time in the field (like lowering concrete rings into a well), discuss the step−by−step procedures in detail in class. Use a model to illustrate the steps. This will help the trainees to keep an overview of the work. It will also help them see themselves as a part of the whole team and process rather than individuals doing just menial work. Discussion beforehand in class is better than trying to explain on the spot in the hot sun when half of the staff cannot hear you.

2. Sit down in the shade with the staff after having completed a new job or after something has gone wrong. Evaluate what happened by asking: What did you learn? What was new? What went wrong? What could be done better?, etc. (see also 2.7). This can help a lot how to judge the situation and how to improve techniques.

3. The same methods can be applied when teaching field work to illiterate people. Using models is even more important.

9. Sanitation



9.1. Importance of Adequate Sanitation

Everybody has to dispose his/her waste matter every day, not only faeces and urine (together called excreta), but also rubbish and other waste.

In each culture, ways have been developed to deal with this problem and in all cultures there are certain taboos regarding waste, and especially regarding defaecation and urination. Everywhere, also, the problems of health and pollution are present. Adequate sanitation means to deal with these problems in an effective way, that is find a solution which is harmless or even useful.

In order to do this, hygiene (= personal cleanliness) and sanitation (= public cleanliness) are equally important and depend on each other. Clean water supply, needed for health and hygiene, must go with taking care of excreta and garbage. If the connection is not considered, diseases spread easily. Therefore, sanitation is an important preventive health measure.

The importance of sanitation will become clear to people if health education and information are based on the daily life experience and practice. Change will only happen if it is convenient and the solutions offered are easy and accessible.

The following questions can stimulate reflection on the topic in a group:

1. Is food a need of your body?

What are your efforts for satisfying this need?

2. Is water a need of your body?

What are your efforts for satisfying this need?

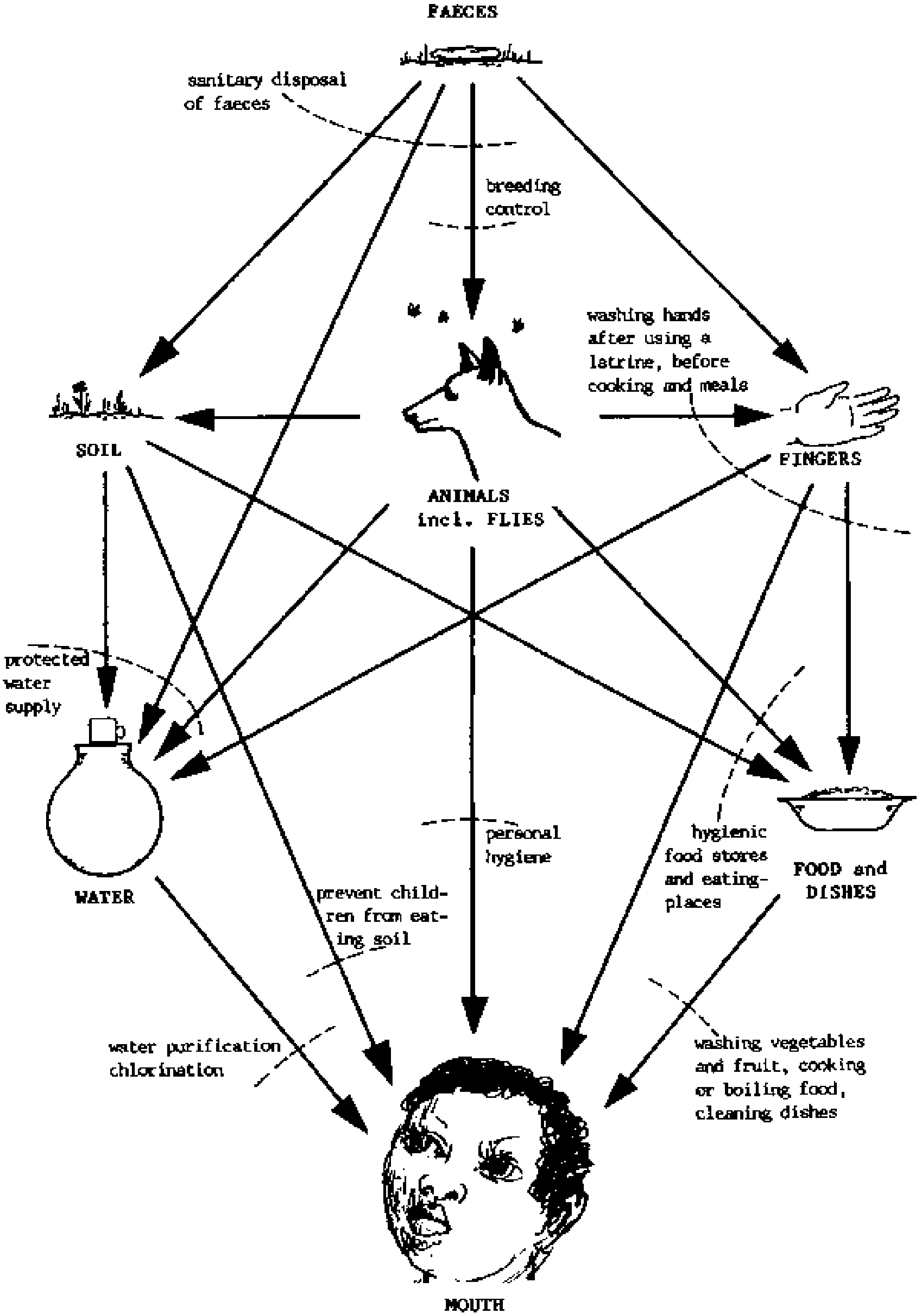
3. Is sleep a need of your body?

What are your efforts for satisfying this need?

4. Is defaecation a need of your body?

What are your efforts for satisfying this need?

The following picture explains the connection between sanitation, water supply and disease, and shows in which ways the transmission cycle can be broken:



9.2. Life Cycles

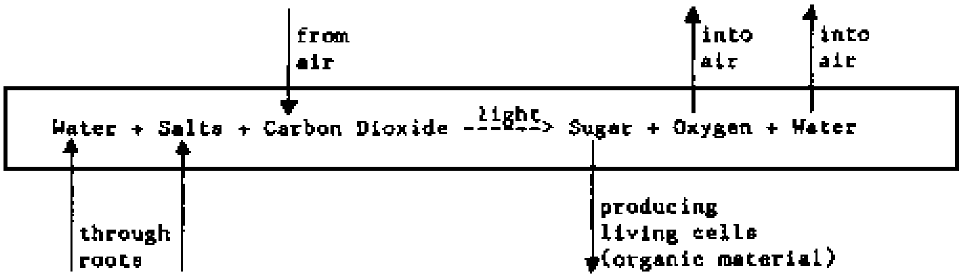
Jn 6,57; 12,24

The world was created in such a way that the different living creatures support and benefit from each other mutually. These processes are repeated again and again, they happen continuously in life cycles. If the life cycles are interrupted or disturbed, there might be no immediate visible reaction, but disastrous effects will show in the long run.

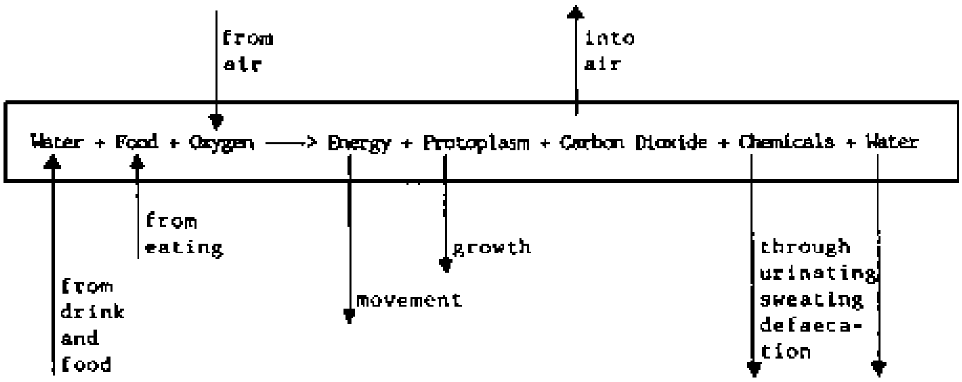
A) Life Processes of Plants and Animals/Humans

The two following basic (and simplified) life processes of plants and animals (including human beings) correspond and supplement each other.

1. Plants: Photosynthesis

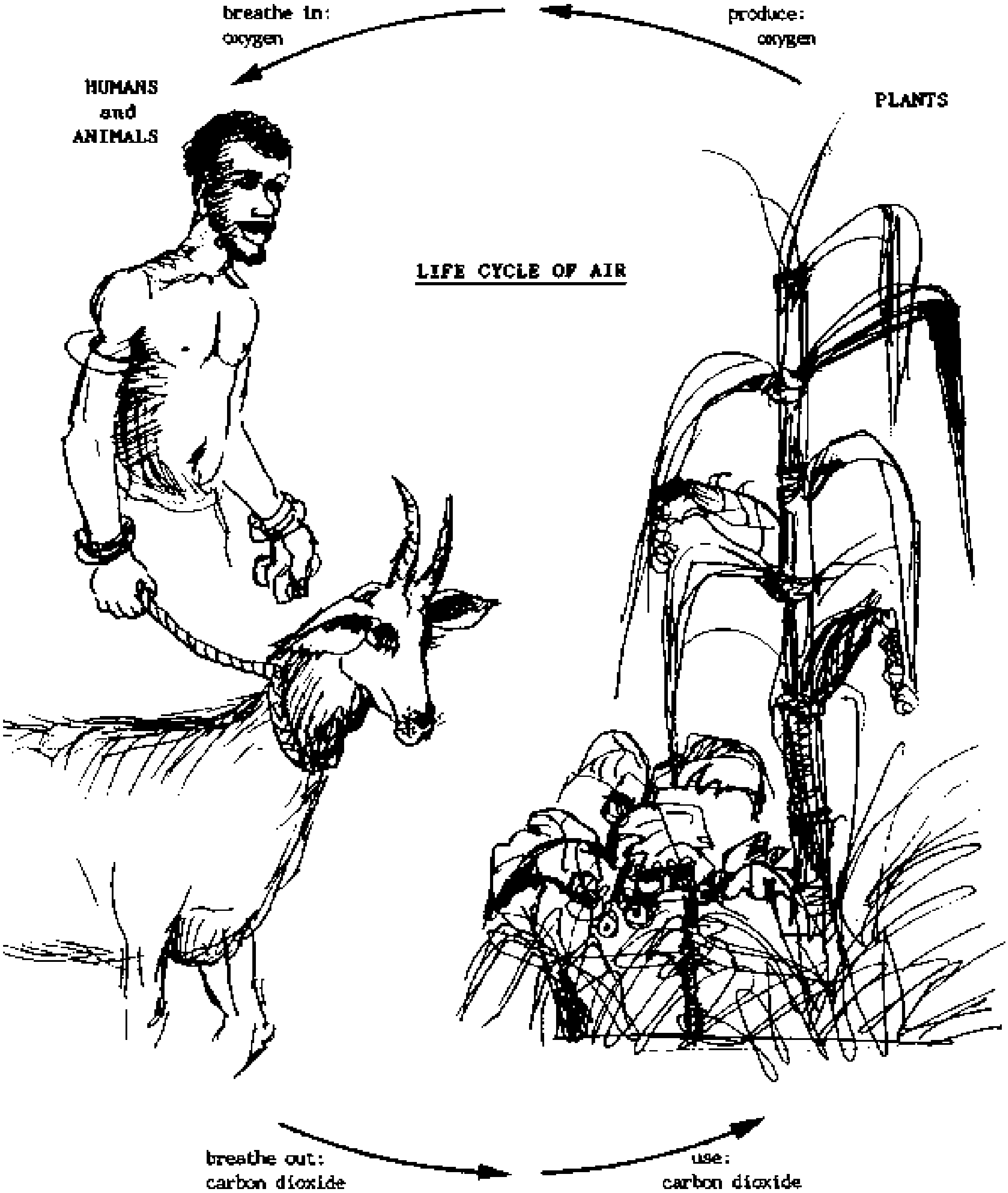


2. Animals and Humans: Respiration



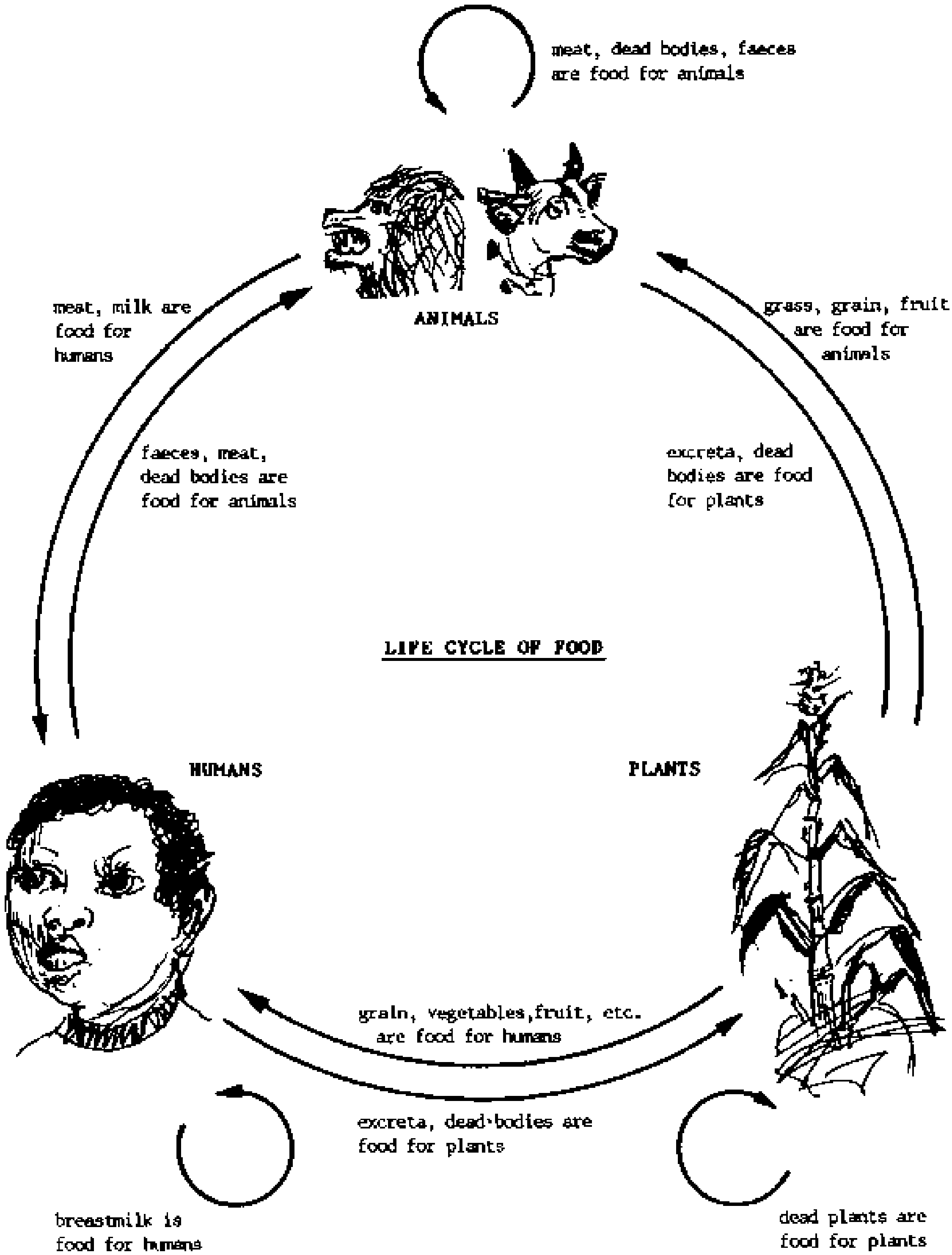
What is a waste product of the plant is a resource for the animal and the human being, and the other way round.

This fact can clearly be shown in the life cycle of air and the life cycle of food:



Therefore:

ONE CANNOT LIVE WITHOUT THE OTHER.



Therefore:

ONE CANNOT LIVE WITHOUT THE OTHER

B) Use of Human Excreta

Problems will arise if the life cycle is interrupted at any place. Using human excreta is one way of fitting into the life cycle.

The following is valid, when using human excreta:

	turns into	
Waste	––––––––––––––––––>	Resource

However, because of the dangers involved, we have to pursue a double aim:

Aim 1:	Avoid Harm	––––––––––––––––>	Control Diseases
Aim 2:	Support Benefits	––––––––––––––––>	Utilize Fertilizer

9.3. Flies/Mosquitoes/Cockroaches

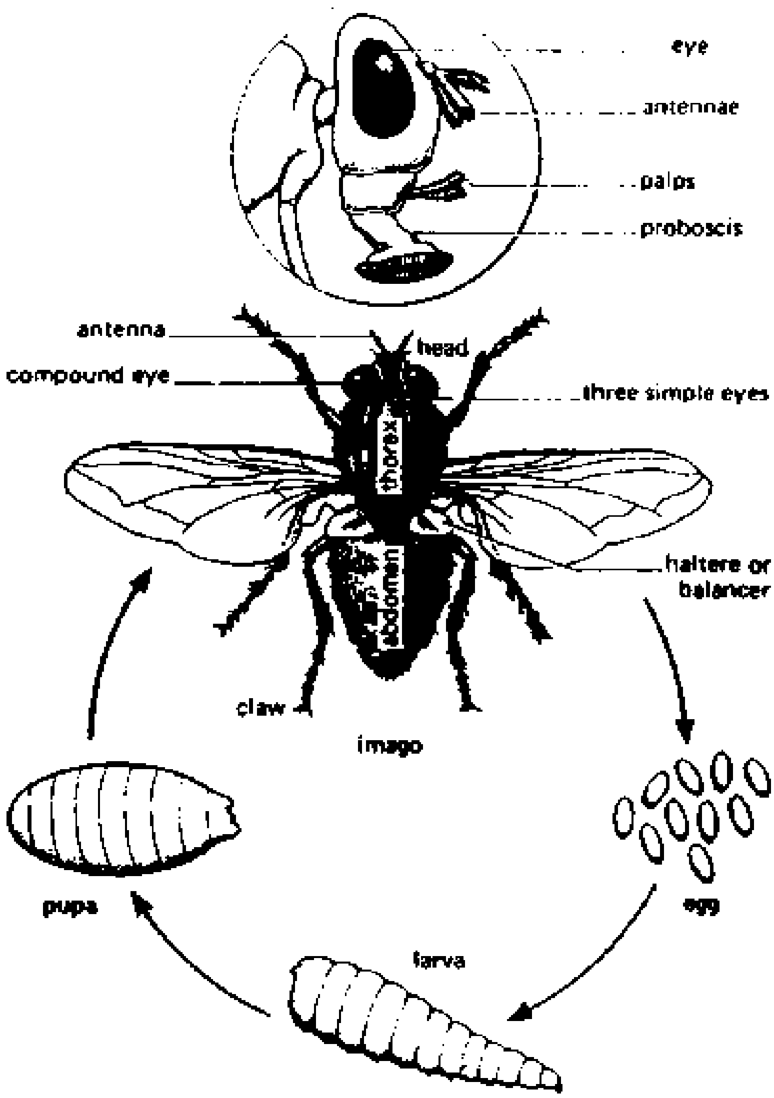
Waste disposal provides two attractive materials for the breeding of insects: rich organic material (that is faeces), and water. The presence of insects and other animal life in latrines is necessary for the break–down of the organic matter and changing it into safe manure. Problems occur if the insects leave the latrine and become carriers of disease (= vectors), either by carrying it mechanically or as hosts.

The three insects most connected with sanitation are:

A) <u>Flies</u>

There are eleven families of flies connected with waste disposal. The most common are the house fly and the blow fly. Their main breeding place is not latrines, but garbage, the house fly preferring more solid material, the blow fly more liquid one.

A female fly lays its eggs into excreta or garbage, about 130 in a batch and 21 batches in her lifetime, that is altogether about 2,730 eggs. After one or two days, maggots come out of the eggs, living on the waste. The maggots become pupae after about ten days and after another 3 to 6 days the adult fly creeps out of the pupa. It lives for about 30 days. The process of developing from egg to maturity varies according to the temperature between 12 and 46 days.

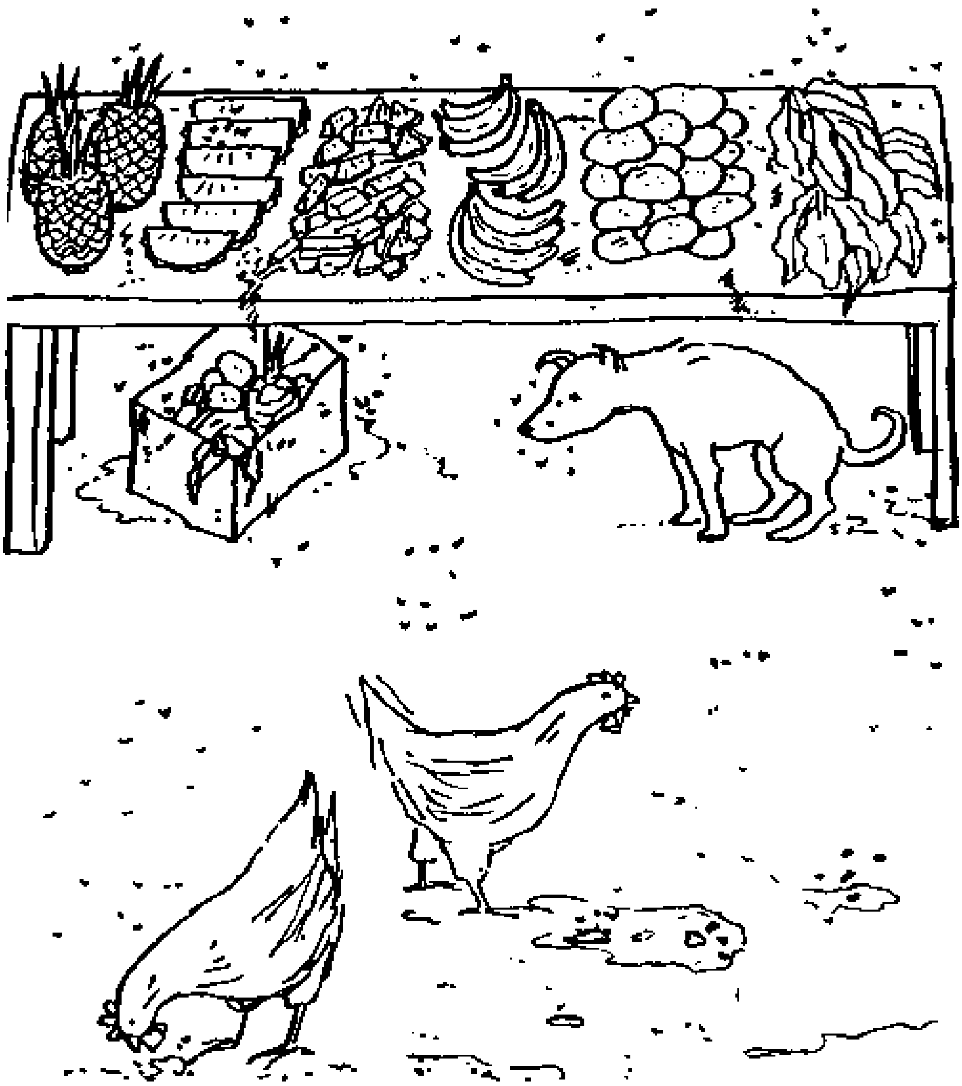


Flies can fly up to five miles in a day and, thereby, transmit diseases over quite a distance.

House and blow flies transmit germs and worm eggs by

- carrying them on the hairs of their feet and body,
- defaecating (every few minutes),
- vomiting.

Other flies transmit diseases by being hosts to parasites or germs and injecting them into the blood of a person when they bite, e.g. sand flies, black flies and tse–tse flies.



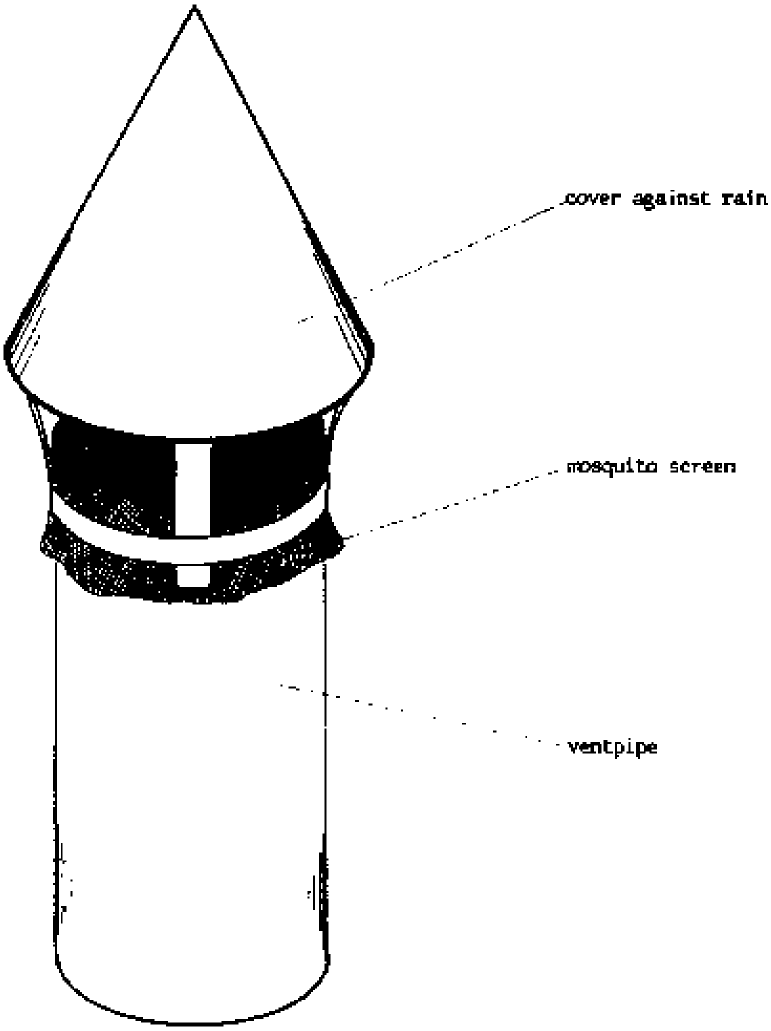
Flies can be controlled in the following ways, most effectively, if method 1 and 2 are combined:

1. Mechanical Control

- Keep general cleanliness.
- Eliminate breeding places, e.g. garbage heaps.
- Build and use latrines properly.
- Use screening, especially for places where food is kept.
- Use a fly−swatter.
- Build and use fly−traps:

Example 1:

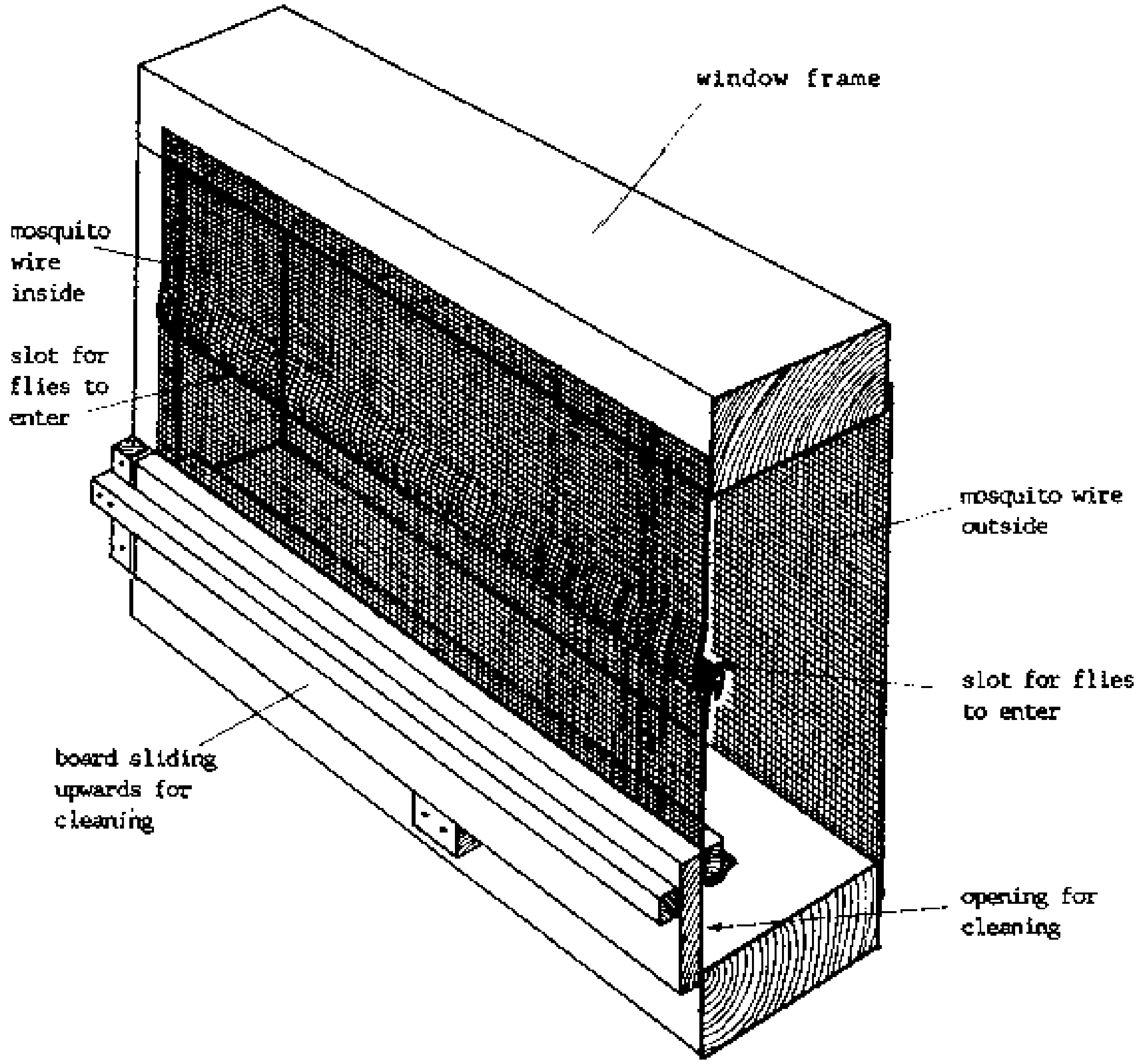
Screened ventpipe for a latrine



Example 2:

Fly−trap window in a latrine

ISOMETRIC VIEW OF CUT FLY−TRAP WINDOW

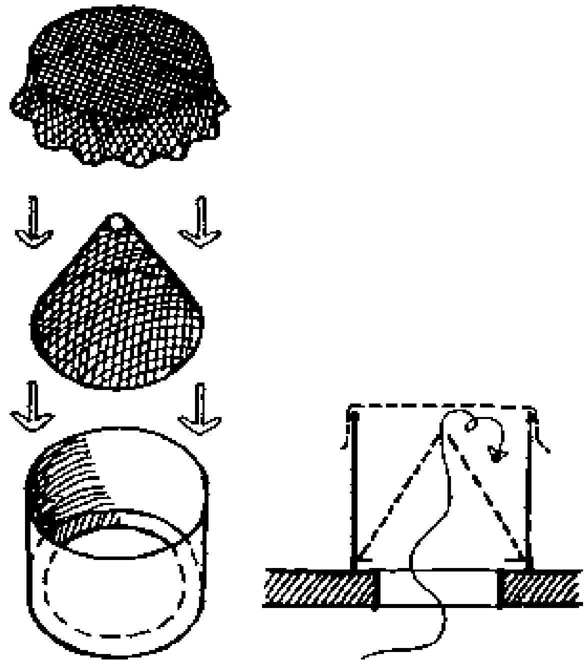


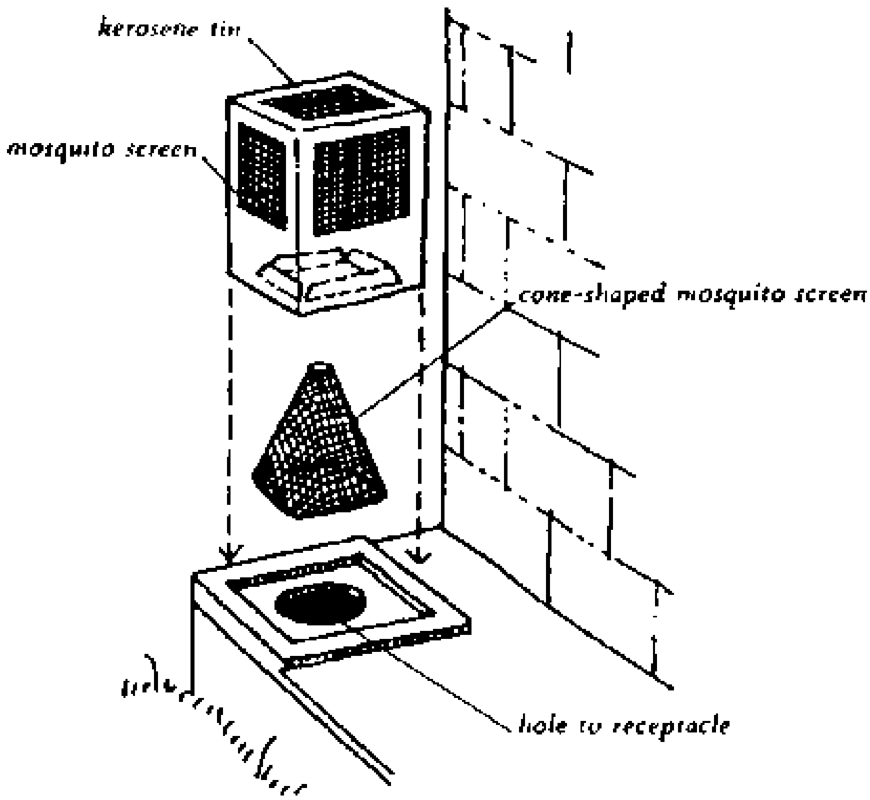
A latrine is usually dark, and the flies are attracted by the light falling in through the window. They enter the fly−trap in the window, cannot escape and die.

The trap is made in a very simple and inexpensive way. Mosquito wire is nailed on the window frame inside and outside. The flies will be trapped in between. The mosquito wire on the inside consists of two parts. They are nailed in such a way, that there is a little overlapping slot in between them, about 5 mm open. The flies will enter through this slot. Another slot of about 3 cm is left open in the bottom for cleaning out the dead flies. This opening is covered with a board, which can slide upwards to allow cleaning. The dead flies can be given to the chicken as food. Such a trap will not catch all flies, but most of them.

Example 3:

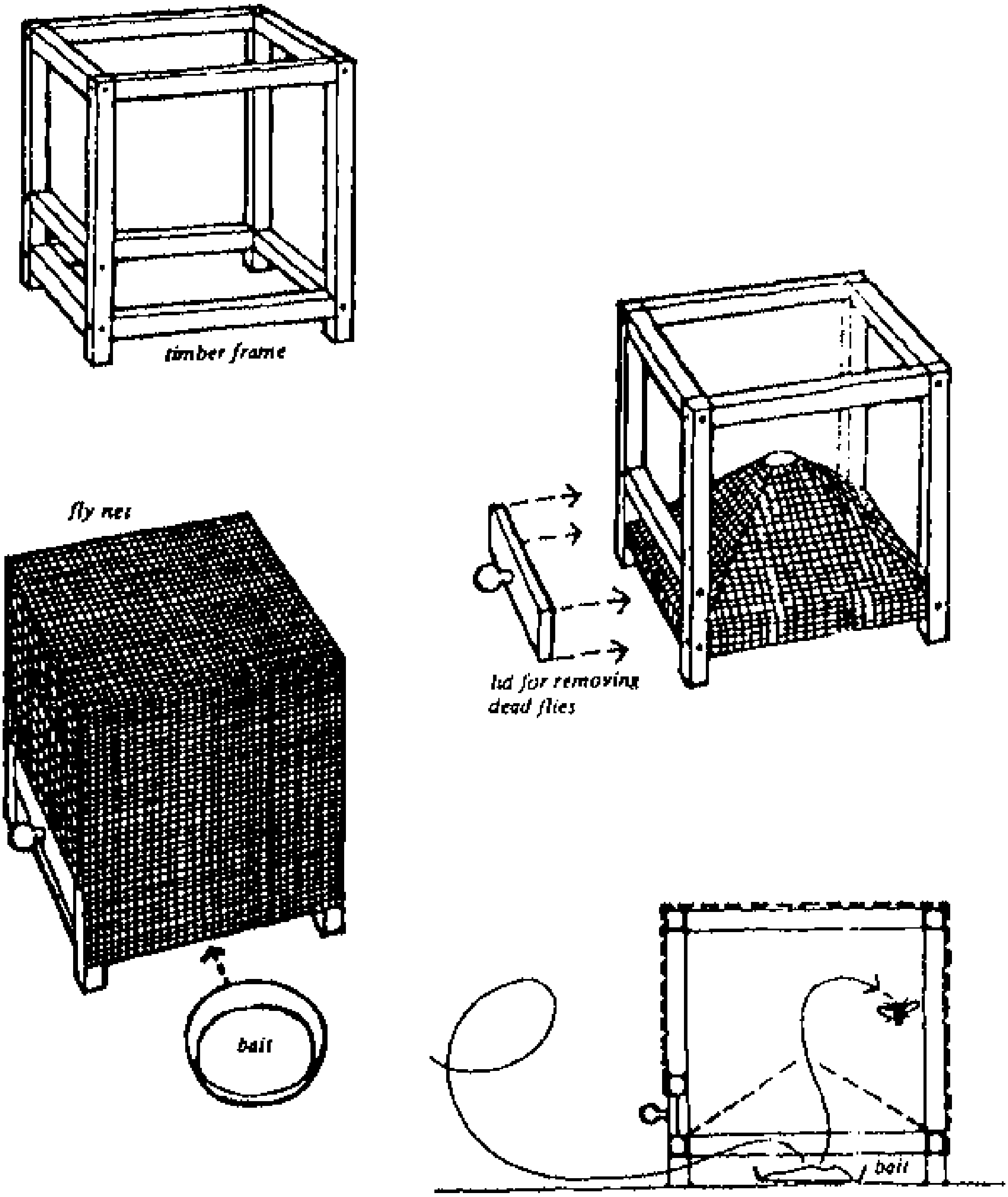
Fly−traps attached to the squatting hole of a latrine





Example 4:

Free standing fly−trap with bait



2. Biological Control

Encourage predators and parasites which live on flies (and mosquitoes) like frogs, lizards, chamaeleons, spiders. Also some birds live mainly on flies and mosquitoes.

3. Chemical Control

Using pesticides can be more harmful to human beings and domestic animals than it is for the pests they shall control. It will also kill the enemies of the flies and mosquitoes. The flies and mosquitoes will develop resistance quickly and will not be affected anymore by the poison.

If chemical control has to be used, take all precautions necessary (see 9.22).

4. Thermal Control

As 40°C is the lethal temperature for mosquitoes and 49°C for flies, burning rubbish or pouring boiling water over it will kill all eggs and larvae. However, this method is dangerous and of limited use, especially for compost latrines.

B) Mosquitoes

Mosquitoes breed in water and some kinds especially in foul water, that is flooded latrines, septic tanks, drains, etc.

There are two types which transmit diseases. That is Anopheles, transmitting malaria, and different Culicinae mosquitoes, transmitting filariasis, yellow fever, Dengue fever, and other virus diseases. The transmission happens when an infected mosquito (only the female) is sucking blood, which it needs to do before laying its eggs, and thereby, injecting the parasites into the blood stream of the person bitten. Other mosquitoes will be infected when sucking blood from this person, and then spread it to other people.

Concerning control see the chapter about flies. The most important is the eradication of breeding places (like filling up pools with standing water),keeping grass short, having screening in the house and keeping doors shut after dusk, and using mosquito nets in order not to be bitten and infected.

C) Cockroaches

Cockroaches need about 7 to 15 months to develop from egg into adult. They also depend on darkness. They are living on organic material and may move from waste matter to food if a place is not kept clean. However, no known disease is spread by cockroaches. They are not dangerous like flies, but rather a nuisance. The best control is to cover food properly to give them no access, and to keep the house clean, airy and light.

9.4. "Germs"

When talking about "germs" in connection with diseases, we have to consider different types of living creatures, most of them too small to be seen by human eyes (= micro−organisms).

They are as follows:

A) Bacteria

Bacteria are everywhere, e.g. 100 millions in 1 gram soil, and also in our bodies. They are adjusted to it and many are helpful and even necessary. We use bacteria, e.g. when making cheese or vinegar. Bacteria do most of the work to transform dead organisms into harmless matter. Most bacteria are not pathogenic (= causing disease).

Bacteria are distinguished as

− aerobic = needing air to live,
− anaerobic = needing no air to live
− facultative = living with or without air.

They reproduce by dividing themselves.

Their names are given according to their shape, e.g., bacilli are rod−shaped bacteria.

Diseases caused by bacteria are for example

− tuberculosis (TB)
− diphteria
− leprosy
− typhoid
− cholera
− tetanus
− pneumonia
− menegitis
− syphilis
− diarrhea (some kinds).

Diseases caused by bacteria can be treated by antibiotics like penicillin etc.

B) <u>Viruses</u>

Viruses are smaller than bacteria. They are consisting of nuclear material (DNA), enclosed in a coat of protein. They are parasites and cannot live outside living cells. They multiply rapidly by division.

Diseases caused by viruses are for example

- measles
- influenza (flu, cold)
- small pox
- hepatitis
- polio
- yellow fever
- aids

Virus–caused diseases cannot be treated with antibiotics, as viruses do not respond to them.

C) <u>Protozoae</u>

Protozoae are single celled small animals which can move. Amoebae are a kind of protozoae.

Amoebae divide themselves into either

- cysts:

  They are covered with a coat and carried outside the body. They are not harmful, unless they reach the intestines of somebody, where the coat breaks and reproduction starts.

- two new amoebae:

  Those divide again and again and live on the mucus covering the intestines. By that they destroy the lining of the intestines and cause bleeding. They move to the liver, but cannot infect other people, as they die shortly after leaving the body.

Diseases caused by protozoae are for example

- amoebiasis
- malaria (transmitted through mosquitoes)
- sleeping sickness (transmitted through tse–tse fly)
- giardiasis

D) <u>Worms</u>

Worms are animals, laying eggs. Some can be several metres long when living inside one's body.

Infection happens, except for the hook worm which comes through the skin, through the mouth by infected fingers, food or water.

The following diseases are caused by worms for example:

- schistosomiasis/bilharziasis (transmitted through water snails)
- filariasis (transmitted through mosquitoes)
- onchoceriasis (transmitted through flies)
- tape worm (transmitted through pig/cattle/fish)
- ascariasis
- whip worm

– pin worm

Clean water and proper sanitation plus personal hygiene and cleanliness are the best method to prevent most of the above diseases. If affected, get proper treatment by a trained person and take the full course of medicine prescribed as it was ordered.

9.5. Diseases Transmitted by Faeces

The following diseases are transmitted by faeces or urine in different ways (see also 8.6):

– polio
– hepatitis
– gastroenteritis
– cholera
– typhoid
– bacillary dysentry
– amoebiasis
– giardiasis
– worms
– schistosomiasis (= bilharziasis)
– filariasis and others.

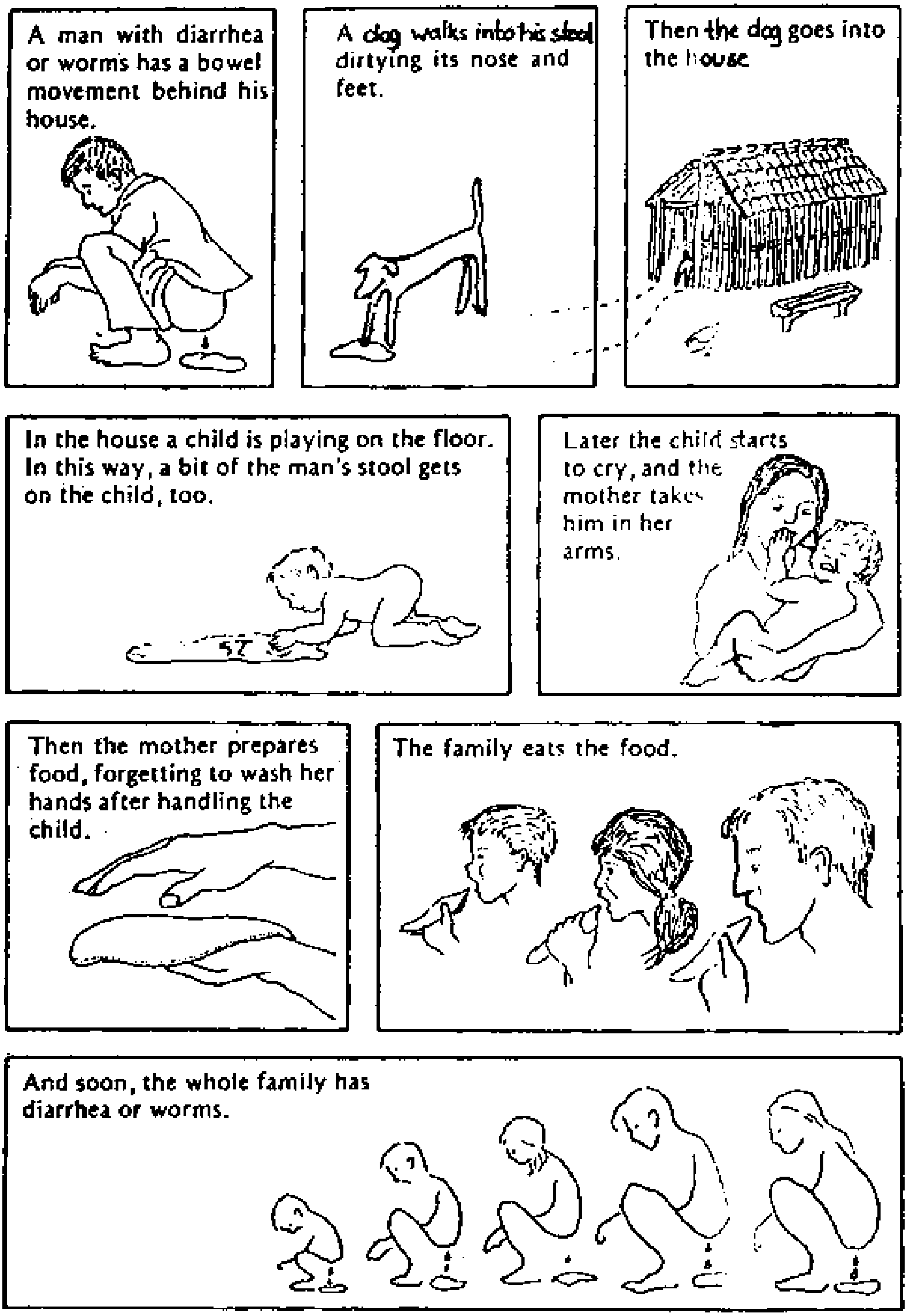
Therefore:

It is indispensable to dispose of human excreta in a sanitary way if we want to reduce and combat the sicknesses transmitted via faeces.

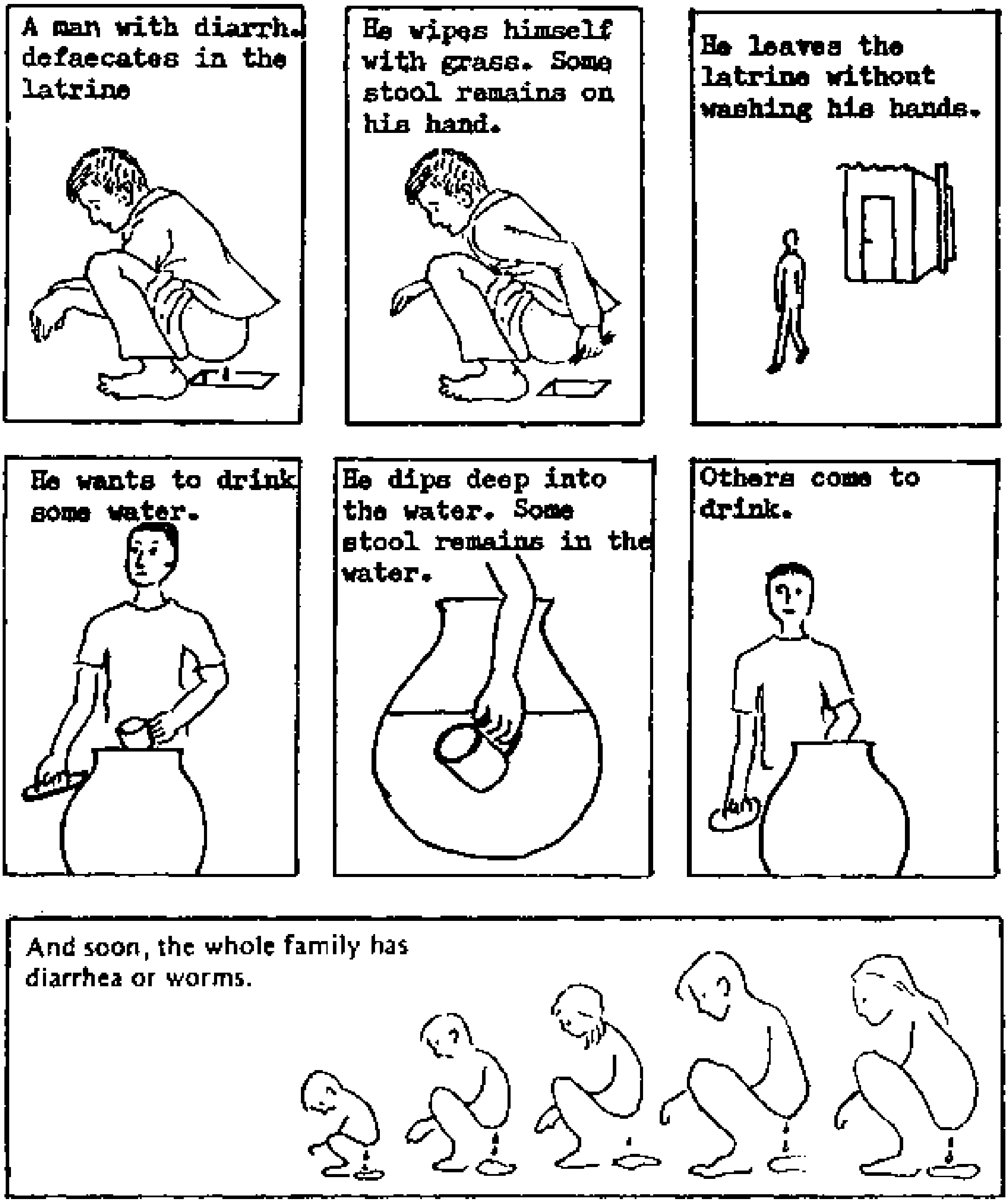
If you want to reduce your suffering from intestinal diseases and the suffering of your family, try to keep to the guidelines and suggestions in the following chapters.

Most time, you cannot <u>see</u> how the contamination is spread and reaches your body. It can happen for example in the following two ways:

<u>Possible Way, How Intestinal Diseases Can Spread</u>



Another Way, How Intestinal Diseases Can Spread (see also 8.38/1f)



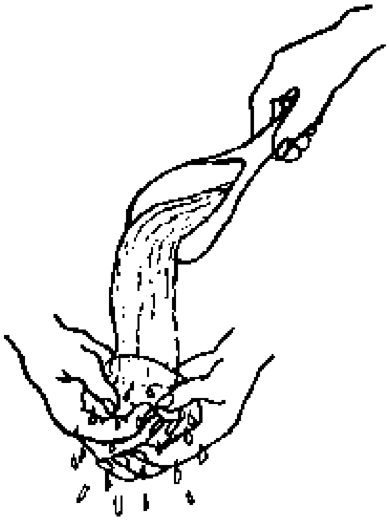
9.6. Basic Guidelines for Cleanliness (Hygiene)

Lev 5,2–3.21.24; 12; 15,7.8.11.12.15.31; Num 19,11.15.16.19; Ez 36,25.29;
Mk 7,14–23; Mt 15,2.10–20; Lk 11,39; Acts 10, 15.28: 11,8–9; 2 Cor 6,6

These are the most important guidelines to be followed:

1. Always wash your hands with soap after a bowel movement. Soap is cheaper than treatment of diarrhea. Have water and soap in or near the latrine, if possible, to remember easily.

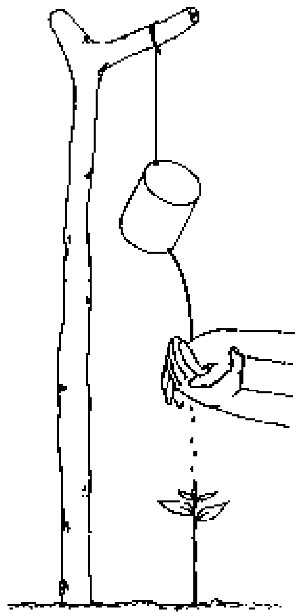
2. Always wash your hands with soap before the meals and not only afterwards. If you have no soap, use ashes. If water is scarce, use the "leaky tin" for hand–washing.



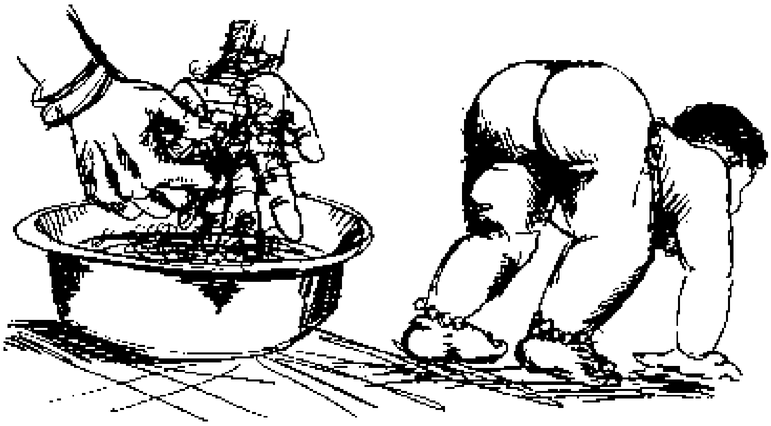
LEAKY TIN:

- Find a small empty tin.
- Punch a small hole near its bottom with a nail.
- Hang the tin from a branch or fix it on a pole.
- Pour only one small cup of water into the tin.
- Mash your hands in the fine stream of water leaking through the hole.
- Plant a tree seedling below the tin.

Design: AMREF, Nairobi

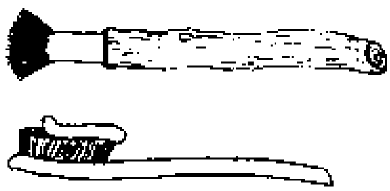


3. After cleaning a baby after a bowel movement, wash your hands with soap.



4. Bathe often. This prevents skin infections.

5. Brush your teeth every day in the morning and evening, and after each time you ate sweets as soon as possible.

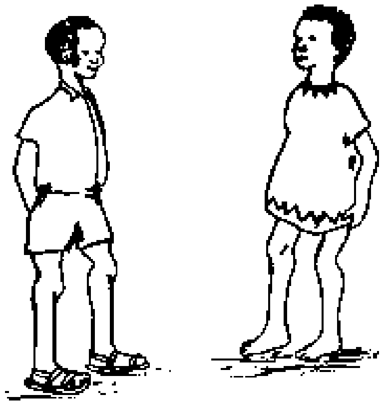


6. Cut your finger nails short.

7. Do not spit on the floor or wall inside the house. Spit can spread disease. Cover your spit outside with some dust.

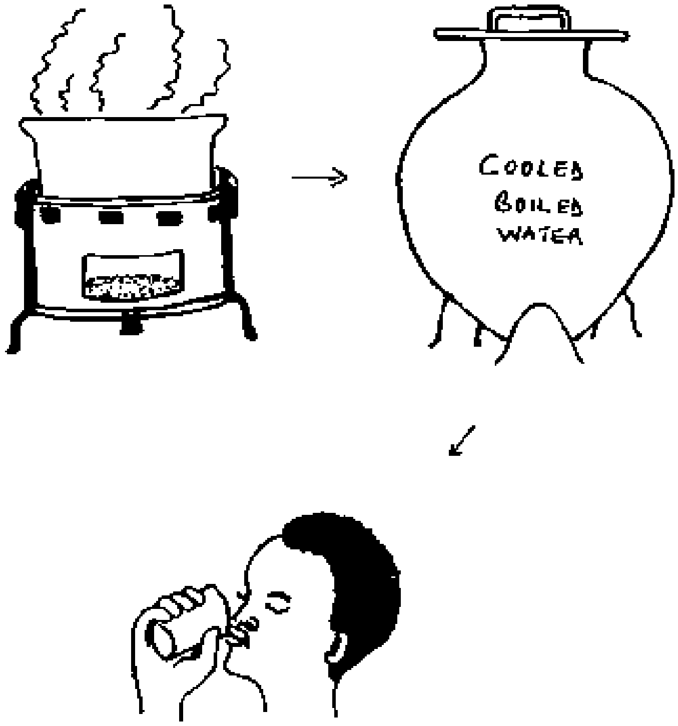
8. De−louse the whole family often. People with lice should cut their hair short, comb it several times per day and wash it with soap. Against clothes−lice boil the clothes and iron it. Lice and fleas carry many diseases.

9. Do not go barefoot or allow children to do so in areas where hook worm or sand fleas are common.

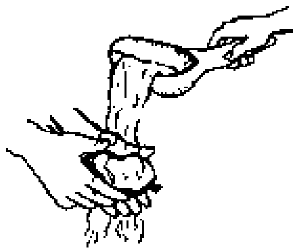


10. Do not let dogs or cats lick children or climb up on beds or tables or come near to the cooking place. Dogs and cats, too, can spread diseases, especially worms.

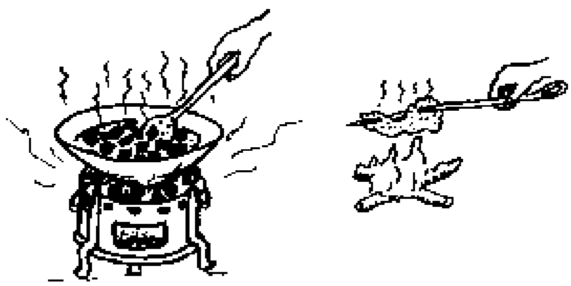
11. Drink safe drinking water (from a safe source or boiled and not contaminated afterwards, from a clean cup).



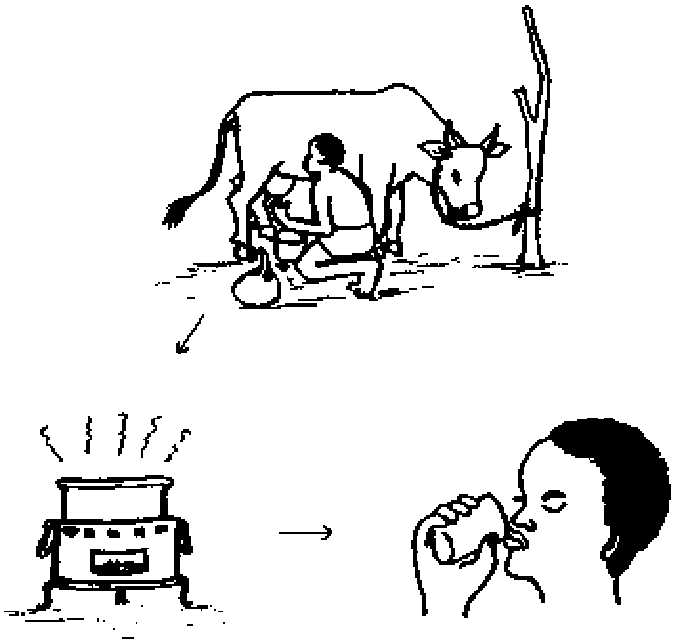
12. Before eating fruits or vegetables, wash them well with water you can drink safely. Insist that children do the same.



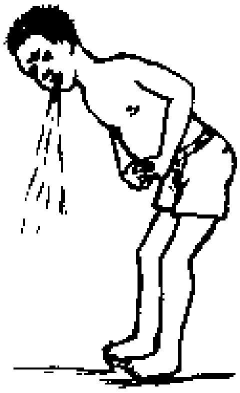
13. Only eat meat that is well cooked or roasted. Be especially careful with liver and intestines.



14. Drink only milk which is boiled.



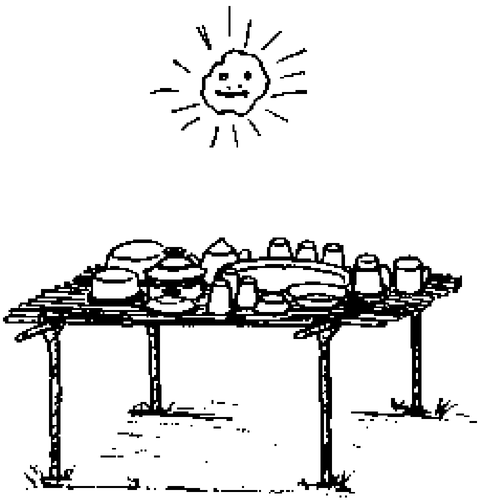
15. Do not eat food that is old or smells bad. It may be poisonous,



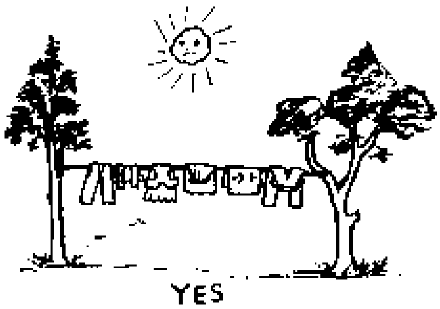
16. Do not let flies and other insects crawl on food; these insects can spread diseases. Do not leave food scraps around; put them into your latrine. Do not leave dirty dishes lying around, as they attract flies and breed germs. Protect food by keeping it covered or in cupboards with screens.

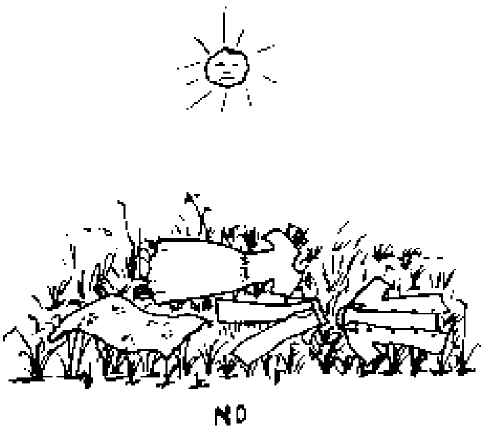
17. People with tuberculosis, flu, cold, hepatitis or other infectious diseases must eat from separate plates and drink from separate cups.

18. Put dishes on a stand after cleaning them and not on the ground.



19. Hang and spread sheets and blankets in the sun often. If possible, do not spread them on the ground, but hang them up. Wash clothes and underwear frequently and hang them up for drying. Iron if possible.





20. Clean the home and compound often. Fill in cracks and holes in the floor and walls, where fleas, bedbugs, cockroaches and scorpions can hide. It is very advisable to smear the floor regularly.

21. If children or animals have a bowel movement in or near the house clean it up at once. Bury it or throw is into the latrine. Better even, get a children's squatting slab and teach the children how to use it.

Reflect on which of these guidelines you have followed already?

Are the guidelines practicable?

Which ones have you not followed yet? Why? Could you change something?

Do all members of your family follow these guidelines?

Discuss all this with them.

9.7. Types of Disposal Systems

There is a wide range of disposal systems for human excreta (= sanitation systems). The following is an overview about the most common sanitation systems. The list is not complete and there are also mixtures of different types in use, but it includes all the systems used in Sudan.

A) Overview of Sanitation Systems

see table page 9.7/2

B) Short Description of the Different Sanitation Systems

1. Defaecation in the Open

see 9.9

2. Pit Latrine from Local Materials

see 9.10

3. Pit Latrine from Permanent Materials

A pit latrine from permanent materials consists of a pit which may be lined, a slab, and a superstructure from permanent materials like bricks, etc.

4. VIP

see 9.11

5. Double Vault Compost Latrine

see 9.12, 9.13, 9.14, 9.16, 9.17, 9.18

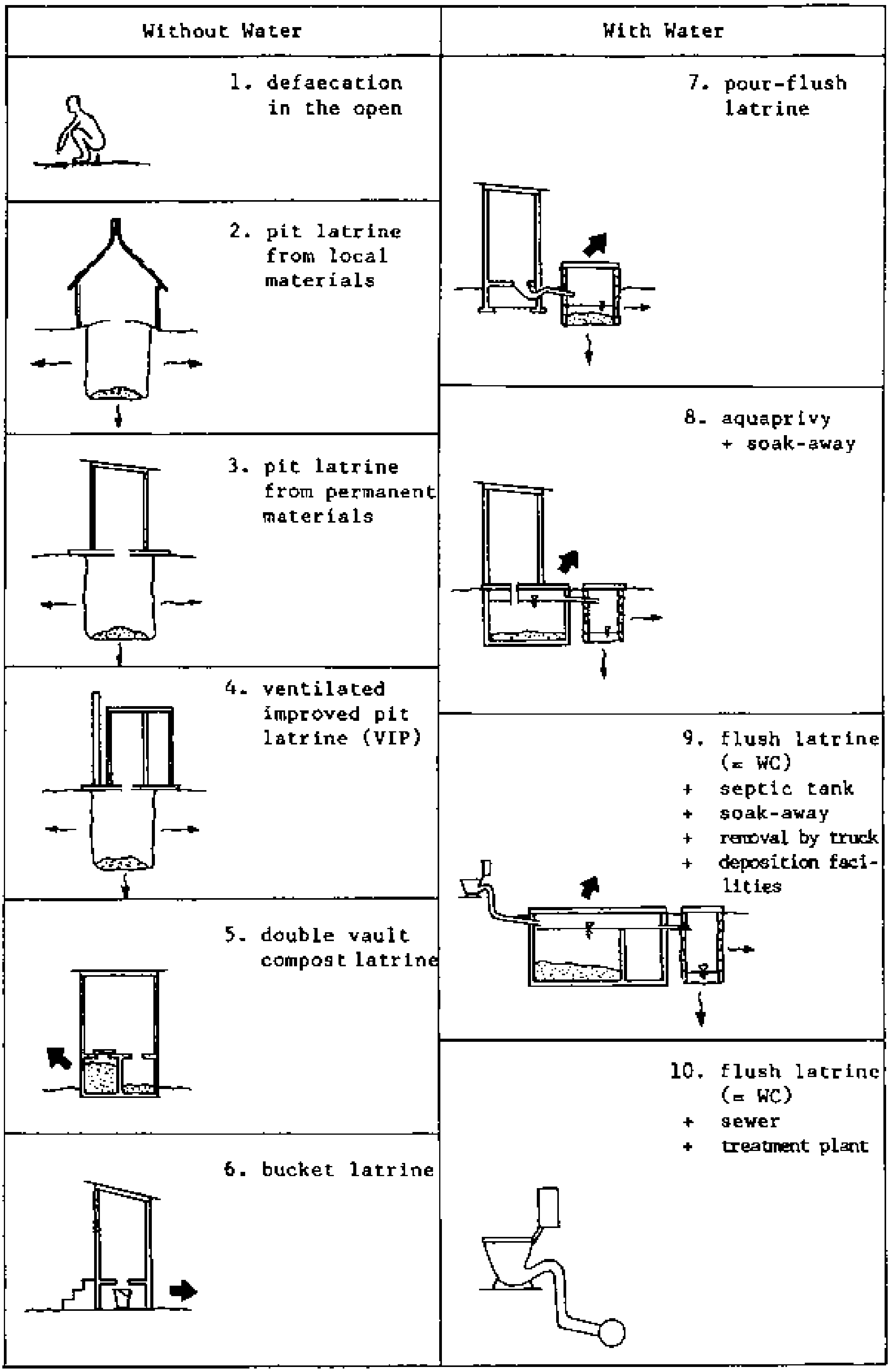
6. Bucket Latrine

A bucket latrine consists of a permanent building with a squatting slab. A bucket is placed from outside underneath the squatting slab. The bucket has to be emptied every time it is full. The contents have to be buried nearby. Handling of fresh excreta is necessary. Flies have easy access to the excrements.

7. Pour−Flush Latrine

A pour−flush latrine consists of a building, a squatting slab with a pan with a waterseal, and a pipe leading to a soak−away pit. After each use, one must flush the latrine with 2−3 lit water. The liquids soak away into the ground, eventually into the groundwater; the sludge has to be emptied from time to time by truck. The septic tank provides a breeding place for mosquitoes.

OVERVIEW OF SANITATION SYSTEMS



8. <u>Aquaprivy</u>

An aquaprivy consists of a superstructure over a septic tank. A chute (= large diameter pipe) reaches into the water in the septic tank from the squatting hole and, thus, provides a seal against smell and insects. The chute has to be washed regularly; water has to be filled into the tank regularly in order to keep the water table constant. Excess liquid flows through an overflow pipe into a soakaway pit and from there into the ground and, eventually, into the groundwater. From time to time the sludge in the septic tank needs to be emptied. For this the superstructure and the slab have to be removed. The gases from the septic tank are dangerous; the septic tank provides a breeding place for mosquitoes.

9. Flush Latrine and Septic Tank

A flush latrine (= WC = Water Closet) is connected with a piped water supply. After each use the toilet bowl is to be flushed with about 20 l water. The contents flow through pipes into the septic tank. Excess liquid flows through an overflow pipe into a soak–away pit and then into the ground and, eventually, the groundwater. The septic tank has to be emptied by a truck regularly. The unsafe contents have to be deposited somewhere. The septic tank provides a breeding place for mosquitoes. Blockage and insufficient water supply make the WC unsafe and inconvenient.

10. Flush Latrine and Sewer

If a flush latrine (WC) is connected with a sewer, the flushed contents flow through a pipe into the main sewer (= a large diameter pipe under the street), and from there into a treatment plant near the next river. There the sewage should be treated (in optimal case mechanically, biologically and chemically). Then the cleaned water is released into the river. Sewage system and treatment are technically sophisticated and very expensive. Therefore sewage water is very often released into rivers without sufficient treatment.

C) Comparison of the Different Sanitation Systems

The features of the different sanitation systems are compared in the following table:

System	No.	Name	Rural Application Possible?	Urban Application Possible?	Construction Costs?	Operating Costs?	Kind of Labour Required?	Selfhelp Possible?	Soi Conditi Requir
without water	1	defaecation in the open	not suitable	not suitable	none	none	none		any
	2	pit latrine from local materials	yes	partly	low	low	unskilled labour	yes	stabl permea soil groundw below
	3	pit latrine from permanent materials	"	yes (in medium density areas)	medium	"	some skilled labour	"	"
	4	VIP (ventilated improved pit latrine)	"	"	"I	"	"	"	"
	5	Compost Latrine (double vault)	"	"	"I	"	"	"	any(ca built ab groun
	6	bucket latrine	no	no	"	high	"	"	"

with water	7	pour flush latrine	partly	yes (in medium density areas)	II	medium	"	partly	stable, permeable soil groundwater deep
	8	aquaprivy + septic tank	"	"	"	"	"	"	"
	9	flush latrine + septic tank + soak−away + removal by truck + deposition facility	no	"	high	high	skilled labour	no	"
	10	flush latrine + sewer + treatment plant	"	yes (in high density areas)	very high	very high	engineer + skilled labour	"	any

9.8. Selecting the Right Latrine

Ez 34,17−19

There are many different sanitation systems. Which is the best?

There is no "best latrine" for all conditions everywhere.

Instead, the best solution for each given condition needs to be selected each time again.

In the following, we give suggestions how to select the right type of latrine for certain conditions. These suggestions are the subjective opinion of the authors and the project staff. Others have other opinions because they have different priorities and different assumptions.

A) <u>Criteria (= Guidelines) for Selecting the Right Latrine</u>

We suggest that the following criteria shall guide our choice:

1. Protection of groundwater and surface water.

2. Protection of health.

3. Saving water.

4. Acceptability by the community.

5. Economic suitability.

Protection of groundwater is the first priority, because groundwater is one of the most valuable and essential resources of the people. In most areas, where people depend on on−site sanitation, they also depend on on−site water supply. Protection of the groundwater is a "must" if we want to protect health and well−being.

Protection of both, individual and public health is essential as well. Therefore, sanitation systems which allow and encourage mosquito breeding and, thus, malaria as well as other transmission of diseases, are questionable.

Saving water, that means to use as little water as possible, is also a high priority, because the majority of people has no access to clean and sufficient water. It seems to be irresponsible to waste water on sanitation, while other reasonable options are available, and at the same time uncountable people have to carry water over long distances and do not get sufficient and clean water at all.

The chosen sanitation system must be understood and accepted by the users. However, this depends very much on and can be influenced by education.

The system should be affordable for the majority of people. It is a great advantage if the users can maintain the system on their own and with their own resources.

B) Sanitation with Water

All sanitation systems with water have the following disadvantages:

1. They support mosquito breeding and, thus, malaria and other sicknesses. Septic tanks and their lids are only tight in theory. Normally, compounds with septic tanks have mosquitoes during the whole dry season. The same is valid for pour flush latrines and aqua privies.

2. Water is not available in such quantities (in a dry country like Sudan) that everybody could use a sanitation system with water. Even in the urban areas, there are many people without sufficient water supply even for drinking, if the water supply is insufficient, all sanitation systems with water become unsafe and inconvenient.

3. Sanitation systems with water endanger the groundwater and sometimes the surface water. The overflow is directed into the groundwater by soak−away pits. Also, many septic tanks are leaking or flooded during rainy season.

4. Sanitation systems with water are considerably more expensive than those without water.

5. Sanitation systems with water spoil quickly if ordinary paper, grass, leaves, corncobs, small sticks or stones are used for anal cleaning.

6. Flush latrines are very often discriminating for village people who never learnt to use them.

Because of these reasons, mainly the first two, we suggest:

Discourage all sanitation systems with water.

The exception may be very crowded urban areas with multi−storey buildings (see also 8.29/5).

C) Sanitation Systems without Water

For obvious reasons like cleanliness, public health, contamination of ground and surface water, and handling of fresh excreta, we suggest:

Discourage defaecation in the open. Discourage bucket latrines.

Thus the choice remains between the different types of pit latrines and the compost latrine.

Groundwater protection is a high priority. Therefore:

Avoid flooded latrine pits by any means.

because they

– endanger the groundwater by bacteriological pollution,
– increase the nitrates and nitrites in the groundwater,
– encourage mosquito breeding,
– are a nuisance for the users,
– can collapse easily (see also 8.7/4).

Therefore:

If the groundwater in rainy season is 2 m below the bottom of the pit, and the next well is more than 50 m away, the pit latrine is suitable.

The reasons are:

The pit latrine

– is simple to build,
– is simple to use,
– and misuse can be corrected easily.

The type of pit latrine depends on the local conditions and the availability of materials.

For areas with high groundwater table there are three options:

– bucket latrine,
– flush latrine with sewer,
– compost latrine.

The bucket latrine is excluded because of hygienical reasons, the flush latrine is beyond reach (for the majority). Therefore, the compost latrine remains the only alternative if we insist on the groundwater being protected.

Therefore:

The compost latrine is the suitable solution if either – the groundwater table is high (less than 4 m at least temporarily), or – the subsoil is rock (digging deep is not needed), or – the subsoil is black cotton soil, or – the owner wants a well and a latrine on the same compound, or – the owner is interested in a latrine which will never be finally full, – the owner is very interested in fertilizer.

A great deal of care and attention for the latrine is necessary, as well as repeated health education. The concerned people (users, project staff) must be ready for that. This is a condition for the functioning of the compost latrines. The costs for a pit latrine and a compost latrine are about the same. Therefore, the compost latrine turns out to be cheaper on the long run if we consider its life time.

D) <u>Maintenance of Sanitation Systems</u>

There is no maintenance free sanitation system.

except defaecation in the open.

If people want to live in more densely populated areas and remain healthy, there is no way out: they will have to participate in the up–keep and maintenance of a sanitation system.

The up–keep and maintenance is the most difficult part of establishing a sanitation system.

This is more difficult than any technical problem. This is valid for <u>all</u> types of sanitation systems. We can see that on the examples when the up–keep and maintenance do not function:

– smelly, dirty latrines, flooded with water, with many flies;
– overflowing buckets;
– blocked pour flush latrines;
– blocked WCs;
– smelly septic tanks;
– streets flooded by not–functioning sewers.

Most books about sanitation are based on the assumption that sanitation with water is the best, only it is not (yet) reachable for most people. This is a subjective and biased opinion, based on certain priorities and the assumption that the technology most common in industrialised countries is good at all and the best for everybody. The above suggestions for the selection of a latrine differ from this opinion. They represent an approach towards water supply and sanitation in which the two fields are seen in connection with each other and on the background of the needs of the majority of people.

9.9. Defaecation in the Open

Defaecation in the open, be it behind the fence of the neighbour or in open spaces or dried up riverbeds, is dangerous. It not only harms the one doing it, but also others who can be infected by diseases transmitted from the uncovered excreta. It harms the community.

This problem was already known–in the times of the Old Testament: "You must have a latrine outside the camp, and go out to this; and you must have a mattock among your equipment; and with this mattock, when you go outside to ease yourself, you must dig a hole and cover your excrement. For Yahweh, your God, goes about within your camp to guard you and to deliver your enemies to you. Your camp must, therefore, be a holy place. Yahweh must not see anything improper among you or he would turn away from you." (Deuteronomy 23,12–14; The Jerusalem Translation)

Therefore:

Contribute yourself to reducing defaecation in the open: – Avoid defaecating in the open. – Construct latrines. – Contribute to the cleaning and up–keep of the latrines you use.

However, there are situations when you are forced to defaecate in the open, e.g. on a journey or when visiting people in a village where there is no latrine. In these cases act in a responsible way:

If you are forced to defaecate in the open – Look for a small hole or dig one with a stick. – Cover your excreta with earth, grass and leaves.

This will ensure quick decomposition and prevent flies from transmitting germs.

In general, urine is a sterile and harmless substance. Thus it is by far less dangerous for transmitting diseases than faeces. However, certain sicknesses are transmitted by urine, too.

Therefore:

If you have hepatitis, typhoid fever, bilharzia (= schistosomiasis), leptospirosis or other serious sicknesses, always urinate into a closed latrine.

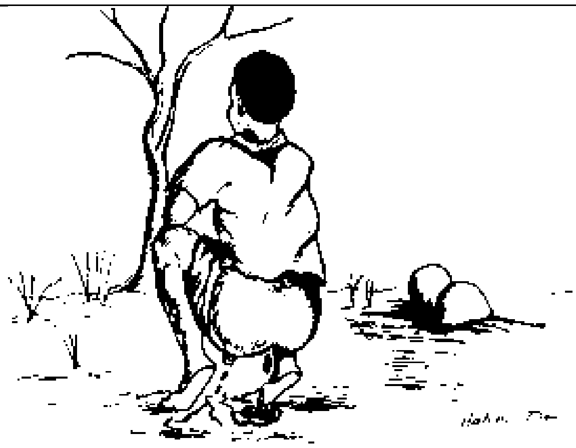
In areas with schistosomiasis (= bilharzia) nobody should urinate in the open, especially not into a river or lake.

A person with schistosomiasis has the disease for life and, unless adequately treated, will continue to pass eggs through the urine.

If you want to use urine as a fertilizer, it must be diluted by water, otherwise it will "burn" the plants (cause them harm because of the great concentration of chemical substances in the urine).

Therefore:

Dilute collected urine with water (1 part urine/5 parts water) and pour it directly in the garden as fertilizer.



9.10. Pit Latrine from Local Materials

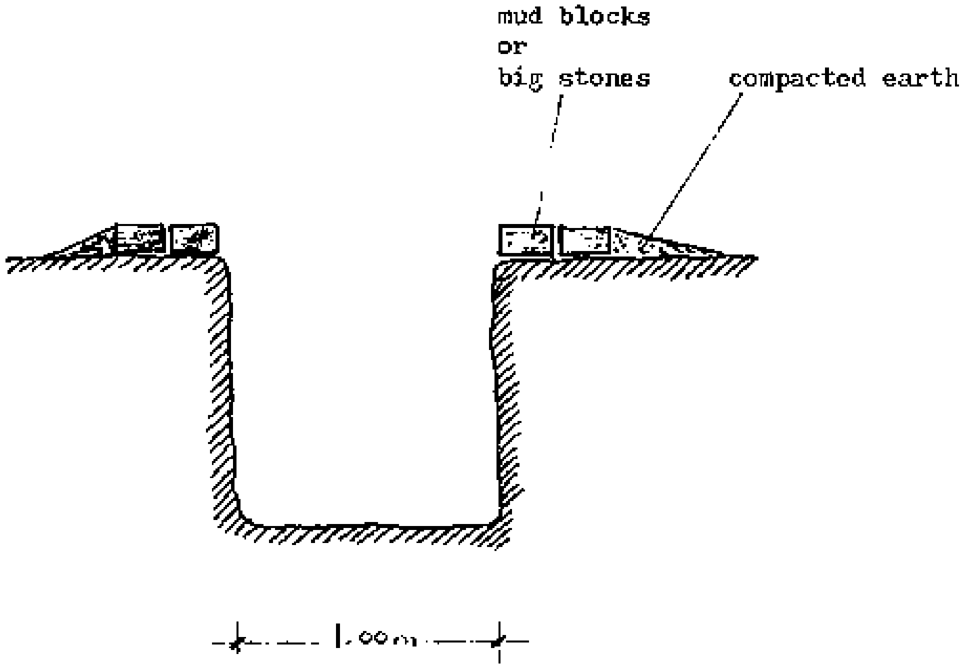
The most simple type of pit latrine, made completely from local materials, is not an ideal solution. But in many places, for example in remote villages or very poor areas, another type of sanitation is not available for people. Therefore, it is important to make the best out of it and use the materials locally available.

Following the guidelines below can improve the latrine considerably. Spread this information among the people who may need it.

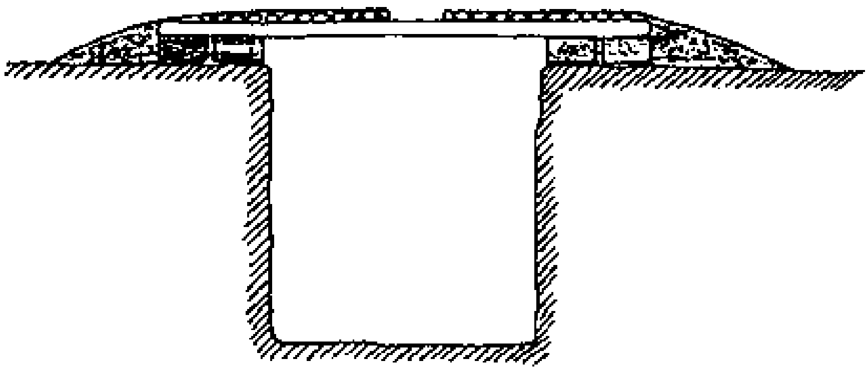
1. Select a location for your latrine which is not flooded during heavy rains, preferably a bit elevated, and far enough from the kitchen and a well, always downstream or downhill from where the water is taken.

2. Dig a pit. It should be small with straight walls, maybe 1.00 m × 1.00 m or round. It should never reach the groundwater. If the water is near or the soil can easily collapse, dig it only 1.00 m or 1.50 m deep.

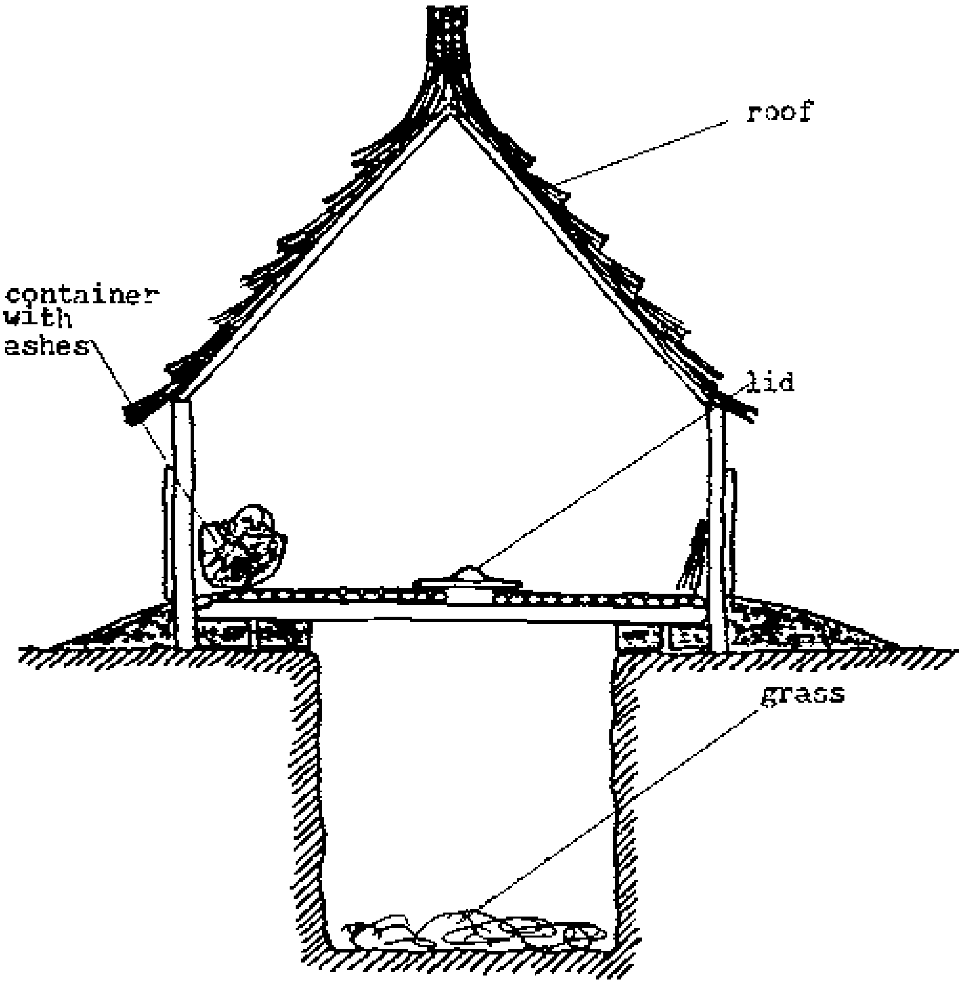
3. Make a few mudblocks or take big stones. Build a collar around the pit or make the collar from mud directly. It is important that the level of the "slab" is above ground. Fill earth around and compact it well.



4. Construct a slab from poles, covered with earth. The squatting hole must be 20 × 40 cm. If it is too small, the latrine will not remain clean.

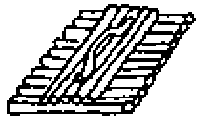


5. Build a roof over the latrine and a wall around if, it is most important to prevent rainwater from entering the pit.



6. Smear the floor. A smeared floor is easier to be kept clean.

7. Build a fitting lid for the squatting hole:



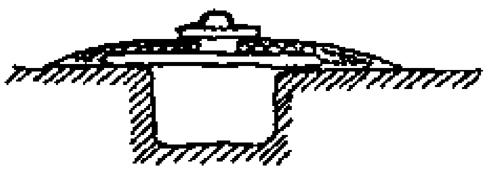
8. Put a container, e.g. a broken clay pot with ashes and sand, a calabash, and a broom into the latrine.

9. Put grass and leaves into the pit before starting to use it.

10. Use the latrine in the way described for compost latrines (see 9.17). Discuss and explain the correct use to the family members repeatedly. Insist on keeping the rules.

11. When the latrine is full, build a new one. Cover the contents of the first with earth. After one year you can dig them out as fertilizer for the garden and you may use the pit again.

12. Build a small children's squatting slab from local material.



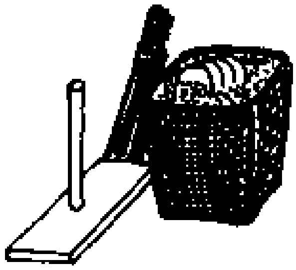
This will help the children to learn how to use a latrine properly. (see 9.19)

Such a latrine will have no bad smell and have few flies and no mosquitoes and will, therefore, be safe if

- the contents of the pit are kept dry;
- the lid is always closed;
- ashes and sand are sprinkled after each use, and grass and leaves regularly added.

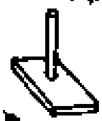
How to improve your pit latrine

1. **Put** a lid, a container with sand and a tin for sprinkling and a broom (not to be used elsewhere) into the latrine!



2. **Put** some sand or ashes into the hole after each use!

3. **Close** the lid after each use!

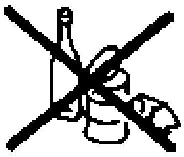


4. **If** dirty, pour sand over the dirt and sweep it into the hole!

5. **Put** grass, leaves, sweepings, kitchen left overs into the hole several times a week!

6. **Do not** pour any water into the hole! Clean the latrine dry or with wet grass, but do not rinse it with water!

7. **Do not** put glass, tins or plastic into the hole!



8. **Do not** use desinfectant, old engine oil or DDT!

Further information:

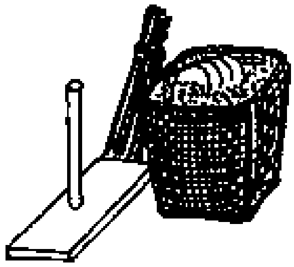
If there are too many flies or a bad smell, a screened ventpipe can help.
If your pit is full of water and mosquitoes, a compost latrine prevents these disadvantages.
Assistance for building a compost latrine and further information you find at:

1985/MGG

Sudan Council of Churches – Munuki Water and Sanitation Project – Juba, Box 209

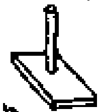
Sika ita bamul mustra betak ahsan

1. Kutu kuta, guffa beta ramla, hilba al ita bekubu al ramla ma huo wa mukshasha fi al mustra! Mukshasha da ma be stamilu fi mahal tani.



2. Kutu ramla walla romat basit fi ufra bad ita stamilu !

3. Gafulu kuta bad ita stamilu !



4. Kan waskan kubu ramla fogu wasaka de wa nadifu jua al ufra !

5. Kutu gesh, warsal, wasaka al nadifu min midan taki wa min madba fi ufra kullu usbu !

6. Ma ta kubu moya fi ufra kullu kullu ! Naditu mustra yabis walla ma gesh al bilu be moya, lakin ma ta kasilu ma moya !

7. Ma ta kutu gisasat walla hilbat walla listic walla naylon fi al ufra kullu kullu !

8. Ma ta stamil Dettol walla Finik walla zet mahruk walla DDT kullu kullu !

Kabar zeda le de :

Kan fi duban ketir walla riha batal, masura be mumulia fi ras beta besadu ita.
Kan mustra taki malyan ma moya wa bauda, bachana min ufraten bewagat kullu mushakil de.
Musada beta abinu bachana min ufraten zeda ita be ligu fi maktab beta mejiles al kanais.

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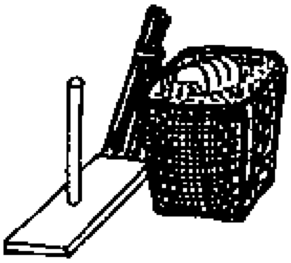
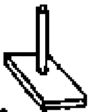
كيف تتحسن البغانك



١ وضع غطاء و العلبة مملوة بالرمل و
الثانية صغيرة التي يمكنك أن
ترش بها الرمل على بلاط و الفرشة
النظافة و التي لا تستعمل في أي
مكان إلا داخل البغانة.

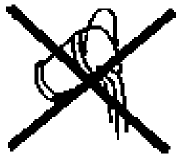
٢ وضع الرمل أو الرماد داخل الحفرة بعد
الاستعمال.



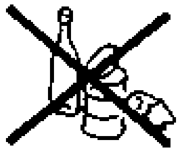
٣ اقفل الحفرة بعد كل إستعمال.

٤ إذا غير منظف دفق الرمل على الأوساخ ثم
نظفها إلى داخل الحفرة.

٥ وضع القش، أوراق، أوساخ و البقاية
الاكل في المطبخ داخل الحفرة مرات عديدة
في الاسبوع.



7 لا تدفق الماء داخل الحفرة، نظف البغانة
نظيفاً بالقش مبلوه بالماء و لا تدخلها
داخل الماء.



٧ لا توضع الزجاج أو الصفحية المقطع أو
البلاستيك الى داخل الحفرة.

٨ لا تستعمل المبيدات للحشرات أو زيت
الماكنة القديمة أو DDT.

معلومات أخرى

إذا هناك ذباب كثيرة أو الرائع أفن ضع ماسورة
تهوية لكى تساعد. إذا البغانة مملوة بالماء و البعوضة
المرحاض تساعد على ذلك. توجد المساعدة للبناء
المرحاض عند مشروع منوكى للاصحاح و الماء.

مجمع الكنائس في السودان، مشروع منوكى للاصحاح و الماء، جوبا، ص.ب. ٢٠٩

1985/MGG

Sudan Council of Churches – Munuki Water and Sanitation Project – Juba, Box 209

9.11. Ventilated Improved Pit Latrine (VIP)

The ventilated improved pit latrine (VIP) was designed to reduce smell and fly nuisance. The main difference, compared with a traditional pit latrine, is the ventpipe.

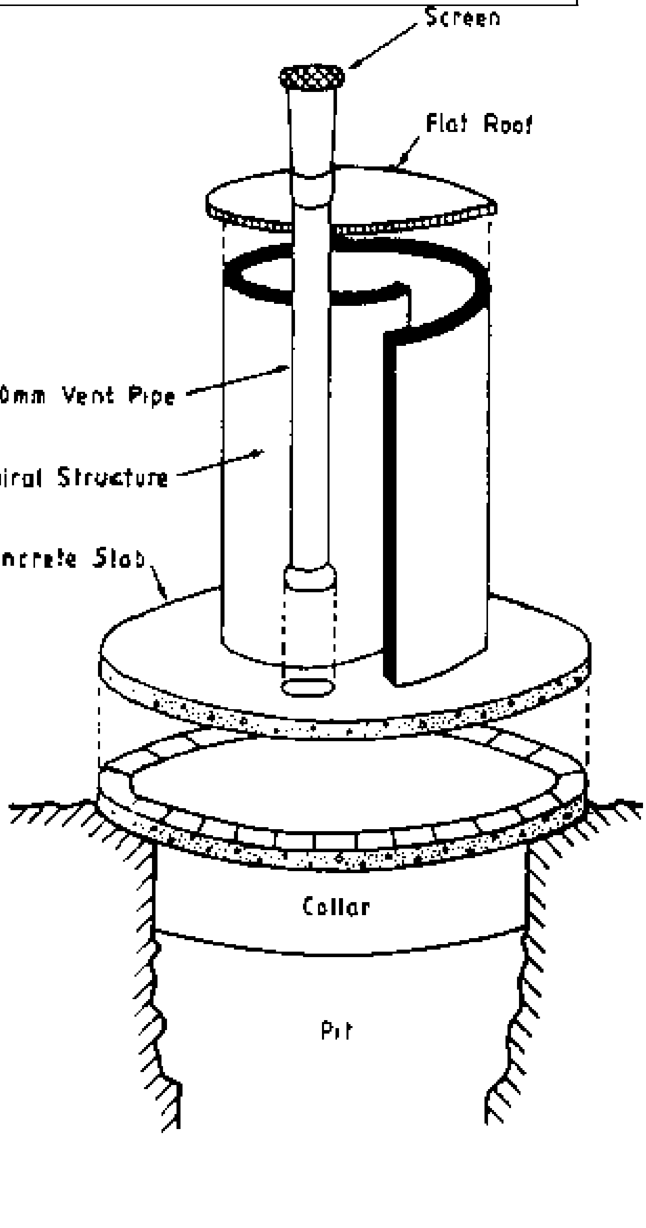
The ventpipe (Ø 8–20 cm) is painted black and placed on the sunny side of the latrine. The air inside the ventpipe will thus heat up and create an updraft to expel bad smells. A corrosion resistant screen on top of the ventpipe prevents the flies from escaping and entering.

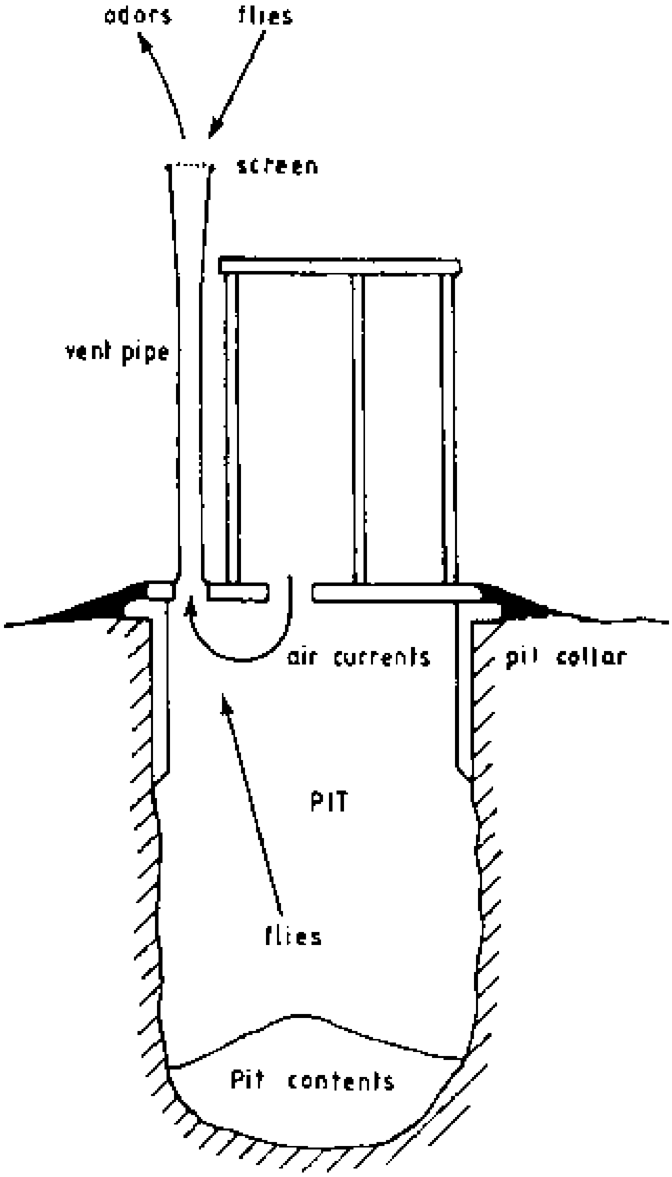
Many VIPs have no removable lid on the squatting hole. The interior of the latrine is dark, as the superstructure is constructed in spiral shape. Thus flies do not escape from the squatting hole, but are attracted by the light falling into the pit through the ventpipe. Dark latrines, however, may cause users to leave the latrine slab dirty. Snakes and scorpions also like to hide in the dark. Therefore, it is more advisable to provide a window and a removable lid.

Whether a VIP is safe healthwise depends on correct use and operation and maintenance; it is best managed in the same way as a compost latrine (see 9.17).

Remember:

A badly kept, dirty pit latrine does not differ from defaecation in the open.





9.12. Compost Latrine

A) Description of a Compost Latrine

A compost latrine consists of a pair of waterproof vaults (= receptacles) that receive excreta, ashes, sawdust, grass, leaves, sand, kitchen residues, etc. Each vault is equipped with a slab with a hole for defaecating, a rear opening for removing the compost, and a hole for the ventpipe.

B) Usage of the Compost Latrine

Only one receptacle is used at a time. The other one is closed by a permanent lid. When almost full, grass and soil are put into it and it is closed. Then the second receptacle is used until almost full.

While the second receptacle is being filled (6 to 12 months), the contents of the first one have time to decompose. Then they are not dangerous anymore for transmitting diseases. When the second is almost full, the first one is emptied and used again. Thus the two receptacles are used alternatively.

C) Special Features of a Compost Latrine

– The compost latrine works as a part of the life cycle, recycling human excreta as a resource, usable as fertilizer.

– If well kept, the compost latrine prevents spreading of diseases.

– There is no groundwater pollution.

– Deep digging is not necessary; the compost latrine can be built above ground.

– The pit cannot collapse.

– Only composted, dry matter needs to be handled.

– The compost latrine is never finally full, but can be re–used again and again.

– The costs are reasonable.

D) Possible Problem Areas of Compost Latrines

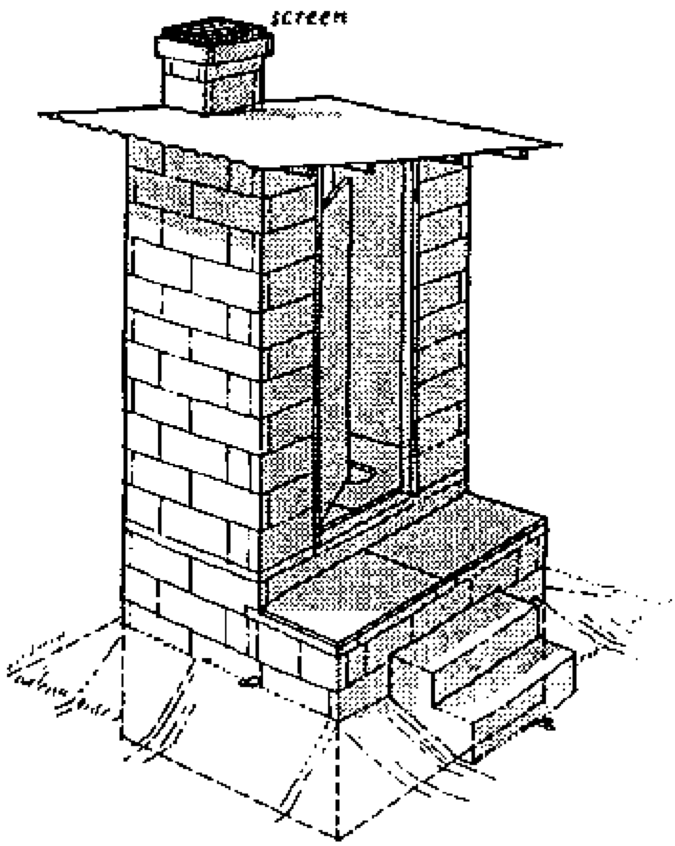
Compost latrines must be used in the correct way (as any other latrines). However, if not used correctly, the contents may not decompose in time, and they will be very unpleasant to empty (like those of a septic tank). Compost latrines need a high degree of care and attention from each user. Intensive and repeated health education is needed for promoting compost latrines.

E) Types of Compost Latrines

There are different types and ways of constructing a compost latrine:

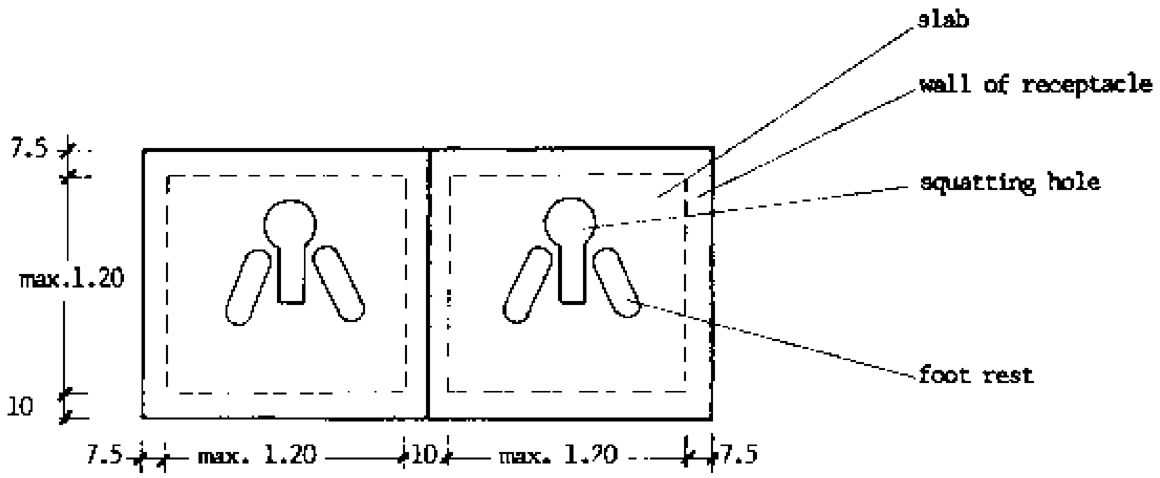
1. Double Vault Compost Latrine below Ground

This compost latrine is built from cement blocks. Basically the same type, but larger and built from bricks, is described in detail in 9.14.

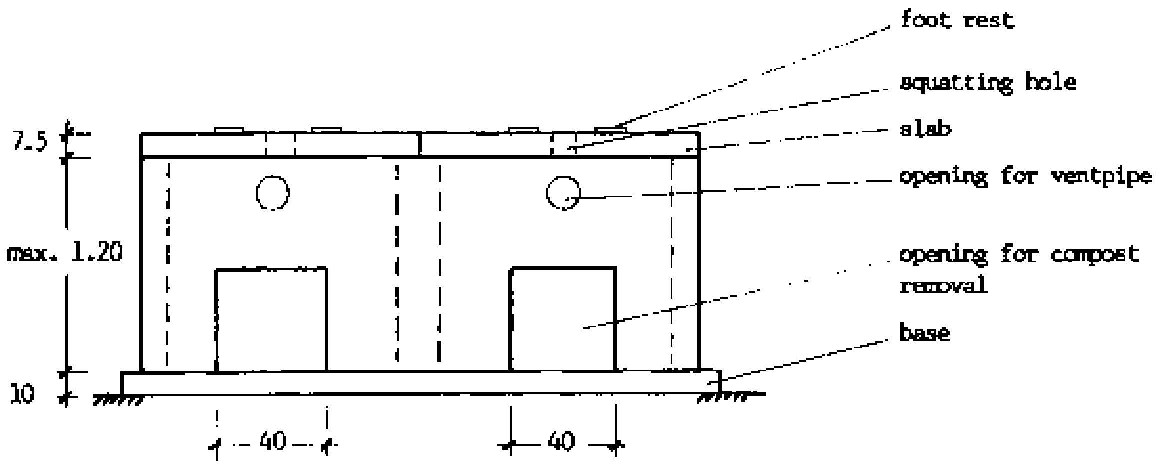


2. Double Vault Compost Latrine above Ground

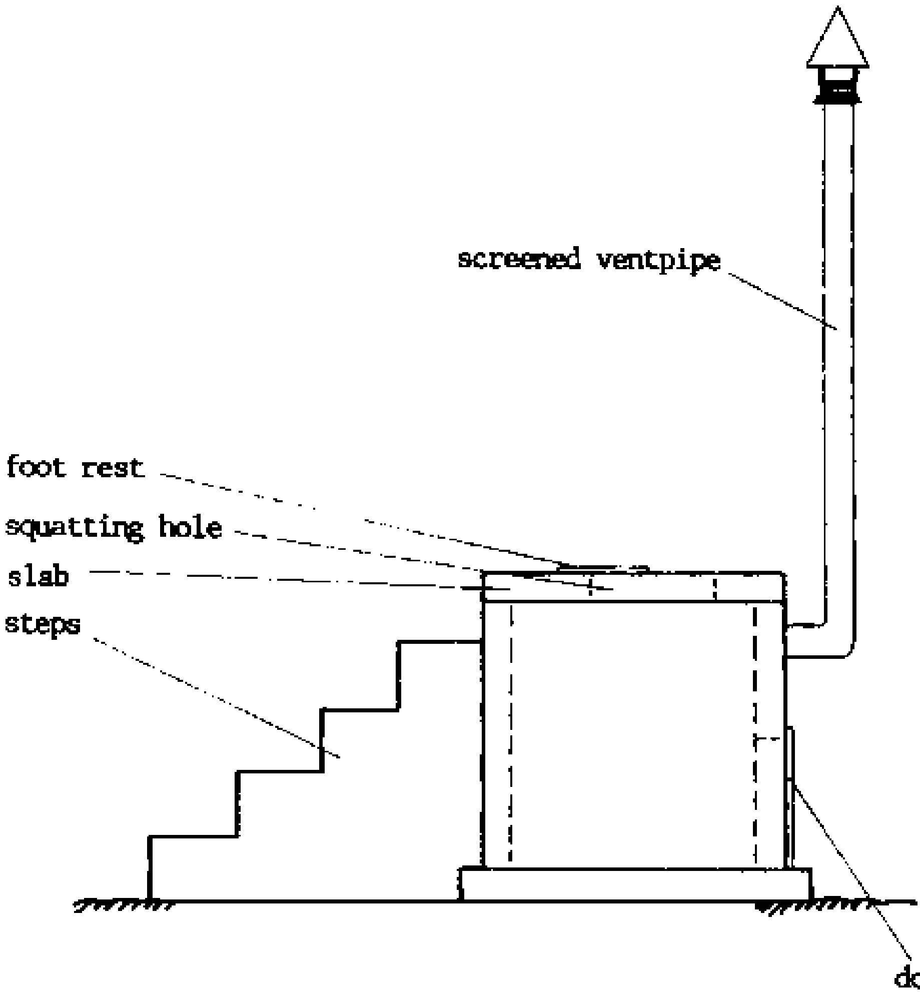
LAYOUT PLAN



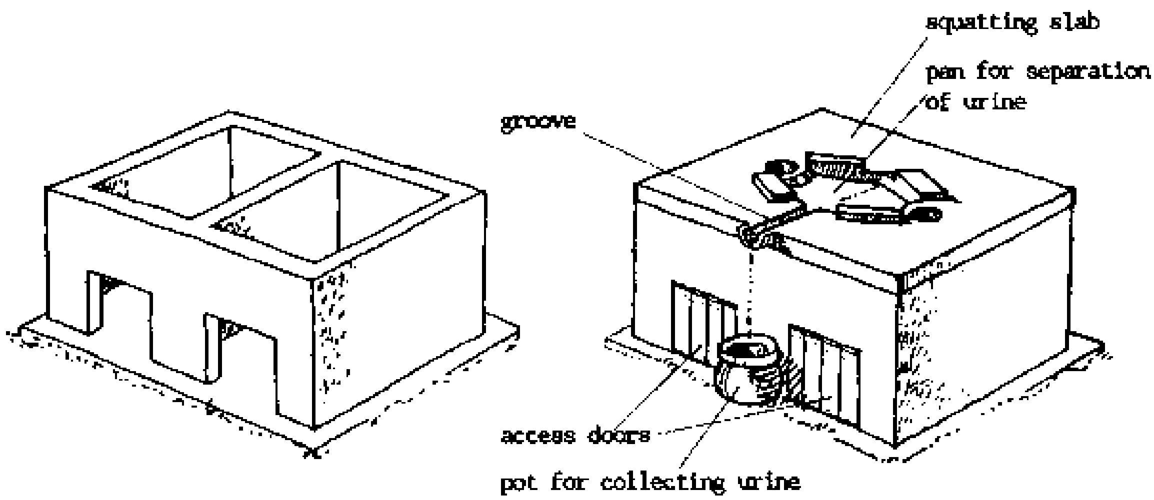
BACK–VIEW



SIDE–VIEW

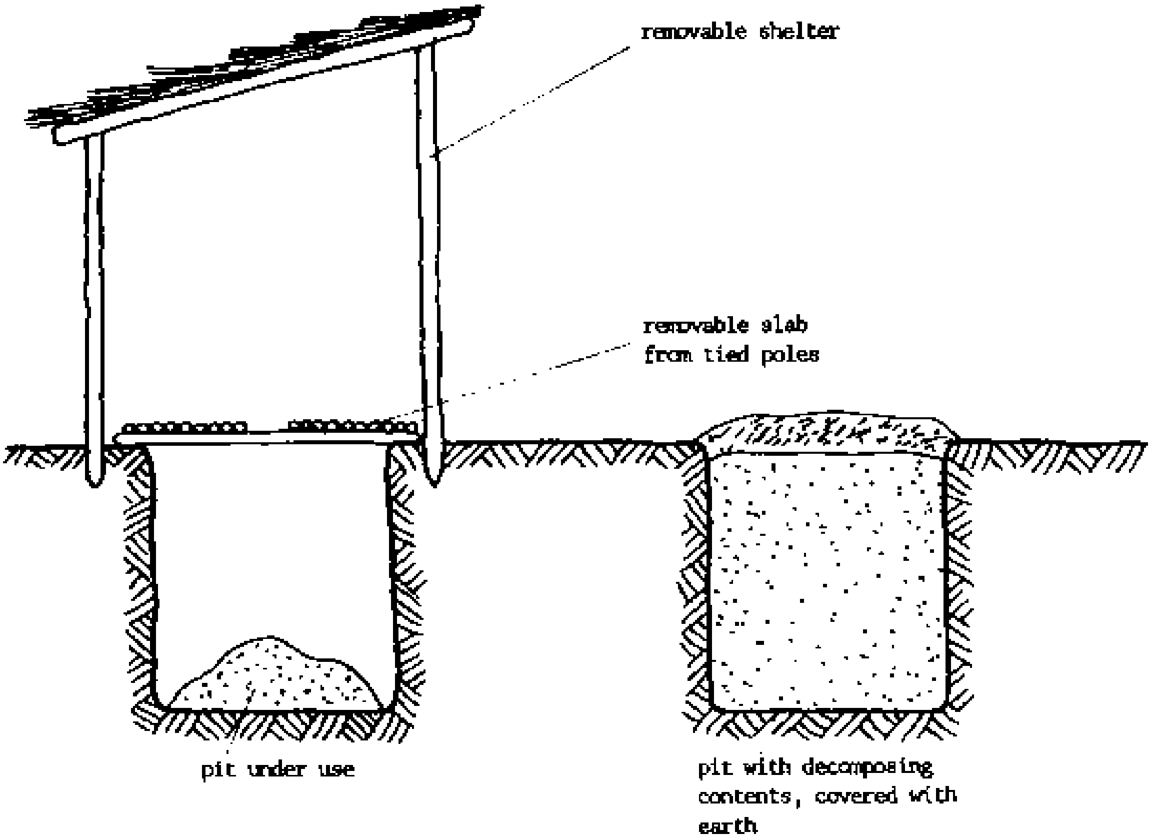


3. Double Vault Compost Latrine above Ground with Separation of Urine (Vietnamese Compost Latrine)



4. Compost Latrine from Local Materials

When the pit is full, a new pit is dug and the slab and superstructure moved on top of it. Six months later the decomposed contents of the first are removed.



F) Example for Advertising Leaflet about Compost Latrines

Sudan Council of Churches * Munuki Water and Sanitation Project

DO YOU WANT TO DO SOMETHING FOR YOUR HEALTH AND THE HEALTH OF YOUR FAMILY???

WHY NOT BUILD A LATRINE?

YOU THINK THERE ARE PROBLEMS?

– The underground is rocky and it will be hard work and expensive to dig.

– Or the water is near and the latrine may be flooded and become a breeding place for flies and mosquitoes.

– Or building materials have become too expensive.

THE COMPOST LATRINE WILL SOLVE YOUR PROBLEMS!!!

– Only one metre deep to dig – the best for rocky ground.

– Completely closed compartments – the best if the water table is near; no flooding anymore.

– Never troubles as with a WC if the water supply is cut – you do not depend on a water supply.

– To be used for generations and it will never fill up finally – once you invest, always you enjoy.

– The waste is turned into manure in a safe way – you can even use it in your garden.

– Cash contribution only £S 250.000 m/ms for the standard version.

For further information contact:

Sudan Council of Churches
Munuki Water and Sanitation Project
P.O. Box 209, Juba

Office Hours:
Monday to Friday, 7.30 a.m. to 2.30 p.m.

YOU ARE WELCOME ANY TIME!

9.13. Composting Process

Composting takes place in the compost heap in the garden or in a compost latrine. It is important to understand the process for being able to maintain a compost latrine properly.

Composting is a biological process. Various types of organisms break down organic substances to make humus (= mature compost). This needs to happen under controlled conditions. Otherwise, decomposition will not take place fully, leaving a foul, smelly mass with pathogenic (= sickness carrying) organisms behind.

The following factors influence decomposition:

A) Availability of Air (Aeration)

Some microbes need oxygen to carry on decomposition (= aerobic decomposition). Others do not require oxygen (= anaerobic decomposition). Both types are going on in a compost heap.

Conditions with enough air available (= aerobic conditions) are necessary for rapid and smell−free decomposition and for destruction of pathogenic organisms by heat.

Air is provided on the surface and by earthworms, maggots, beetles, cockroaches, and others digging into the heap. Obviously, in flooded pits with too much moisture, the material becomes soggy, compact and unable to contain sufficient air in between the particles.

B) Temperature

Dry decomposition produces a lot of heat. In the middle of a compost heap it can reach 50°C. High temperatures contribute to the destruction of pathogenic organisms.

C) Moisture

The best moisture content in a compost heap is 50−60%. Too much or not enough moisture are both bad for the composting process. An extremely wet latrine is bad for composting and invites mosquito breeding. It can be caused by

– humid climate,
– water used for anal cleaning,
– urine and faeces deposited,
– too many users,
– no addition of organic refuse,
– no addition of sand, ashes or other dry matter,
– an unventilated receptacle,
– entry of rain water, surface water or groundwater.

Take care that the compost is not too wet and muddy by regularly adding enough dry material.

If it is wet, check the cause and remove it.

D) Ratio of Carbon and Nitrogen

Carbon and nitrogen are two different chemical substances found in nature.

Microbes feed on organic matter containing, amongst other things, carbon and nitrogen; they use carbon for energy and nitrogen for body building. The carbon and nitrogen content must be balanced in a compost heap. It is best if there is 15 times more carbon in the compost than nitrogen (Carbon/Nitrogen ratio = C/N ratio = 15/1).

Faeces have only 8 times more carbon than nitrogen (C/N ratio = 8/1); urine has even less carbon than nitrogen (C/N ration = 0.8/1). Therefore, it is very important to add carbon−rich material in order to reach the correct balance.

Carbon rich materials are all organic materials (such as grown plants) especially:

– ashes	Almost all carbon
– sawdust	C/N ratio = 500/1
– straw	C/N ratio = 150/1
– green leaves, grass, kitchen residues	C/N ratio = 15/1

Therefore:

Regularly pour ashes, leaves, grass, sawdust, etc. into the compost pit in big quantities. Put all kitchen residues into the pit.

Do not worry about the pit being filled too quickly. The volume of all these materials is very much reduced during decomposition.

E) Life in the Compost Heap

A variety of organisms live in a compost pit, like viruses, bacteria, fungi, algae, earthworms, fly maggots, snails, ants, spiders, beetles, cockroaches, mice, etc. They play a major role in mixing, airing, and tearing apart the contents of the latrine. As long as they remain inside the receptacle, their activities are good and should be encouraged. They should not be killed by chemicals or poisons or disinfectants poured in. But we do not like to see such organisms outside the receptacle.

Therefore:

– Always keep the lid closed.

– Check the screens on the ventpipe for eventual holes and repair.

– Keep the covers for emptying well covered with earth.

– Sprinkle ashes and sand after each use to reduce flies.

– Do not throw tins, glass, plastic into the receptacle.

– Do not pour DDT, old engine oil or disinfectant (Dettol, Finik) into the pit (see also 8.7/4).

F) Destruction of Pathogenic Organisms

Pathogenic organisms are destroyed by

– high temperatures,
– time,
– unfavourable pH value (alkalinity or acidity),
– competition for food,
– antibiotic action,
– toxic by–products of decomposing organisms,
– anaerobic conditions.

After six months in a closed receptacle, the contents of a well–functioning compost latrine are safe enough to be taken out.

Take them out and cover them with soil. Most parasitic organisms have been destroyed.

The period of one year in a closed receptacle is on the safe side. All pathogenic organisms are destroyed.

However, if the compost latrine was not well kept, or no organic material was added, or the contents are muddy, it will be unpleasant to remove the contents. Dispose of them in a trench and cover them immediately with earth. Learn from experience and keep the latrine better next time.

G) Compost as Fertilizer

Addition of compost will make the soil more fertile, easier to cultivate, and improve its water holding capacity. The fertilizer from compost is well balanced in all its ingredients. Plants can use it almost 100%. Compost does not endanger the groundwater as chemical fertilizers do. Compost is a treasurable resource.

9.14. Compost Latrine Construction

Three different designs for compost latrines are described here:

1. Compost latrine, standard size (15 – 25 people), from permanent materials;

2. Compost latrine, standard size (15 – 25 people), with local superstructure;

3. Double compost latrine, large size (100 – 120 people), from permanent materials;

The construction steps and the materials needed are given for the first design only. However, they are similar for the other designs.

A) Designs

1. Compost Latrine from Permanent Materials

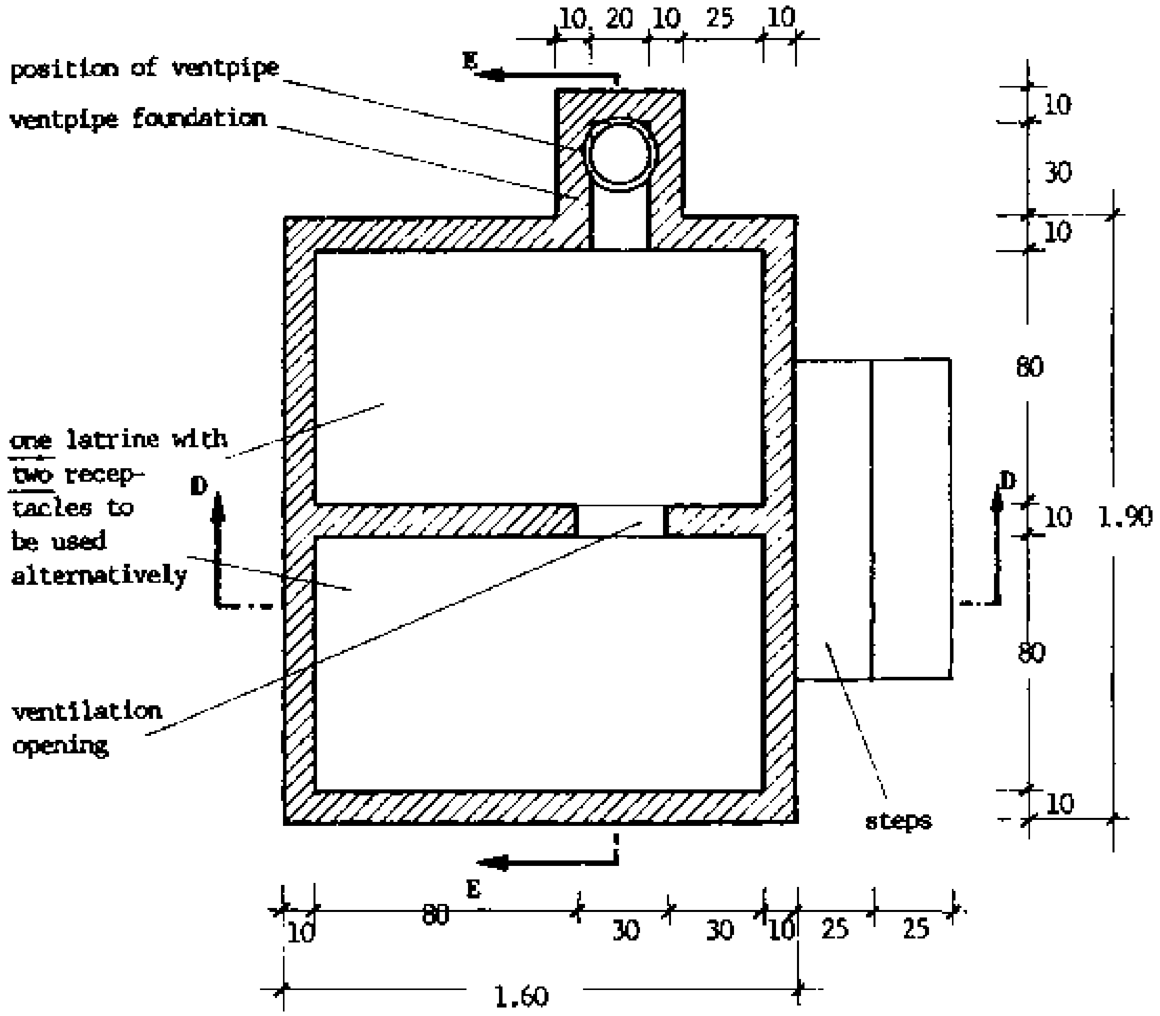
The compost latrine, standard size, is intended for extended families. The volume of the two pits together is about $2.7 m^3$; this is equal to the volume of an ordinary round pit Ø 1.00 m, 3.50 m deep. It is built from half–brick wall throughout. Additional reinforcement in the slabs makes it unnecessary to have a beam to bridge the pits.

Prefabricated Parts:

Quant.	Item	Measurements	Remarks
2	concrete slabs with squatting hole and foot marks	95 cm × 110 cm × 5 cm	reinforcement: welded mesh and 1 Ø 10 mm
2	concrete covers	50 cm × 110 cm × 5 cm	reinforcement: welded mesh; two handles

1	lid from cement mortar 1:4	53 cm × 20 cm × 5 cm	see 9.14/19
1	wooden lid with handle	53 cm × 20 cm × 2 cm	see 9.14A9
1	ventpipe from ferrocement	inside Ø 20 cm, outside Ø 25 cm, length 2.70 m	reinforcement: chicken wire with screen and rain−cover

LAYOUT PLAN A−A PITS



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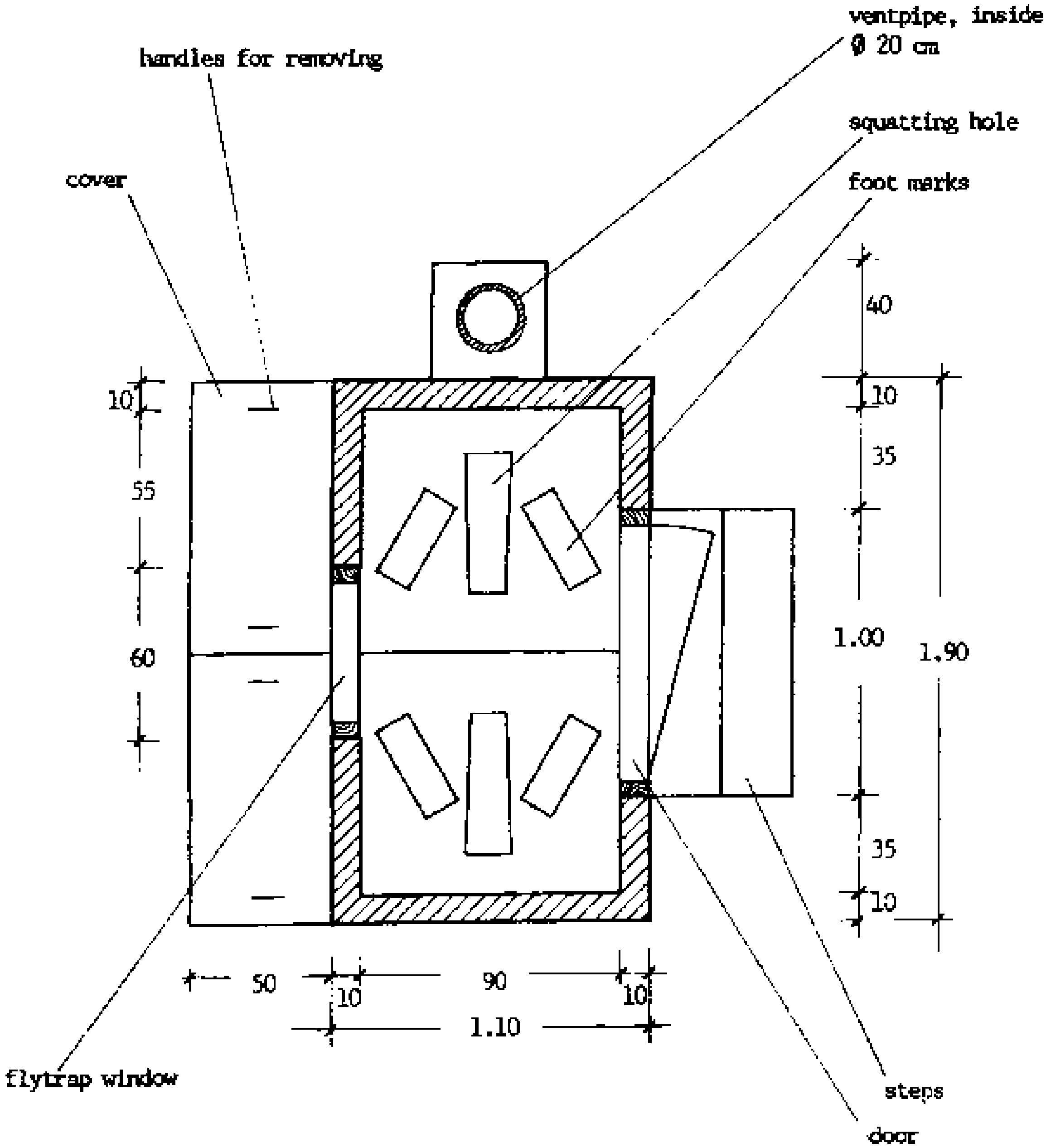
How to read technical drawings is explained in 6.1.

LAYOUT PLAN B−B SUPERSTRUCTURE



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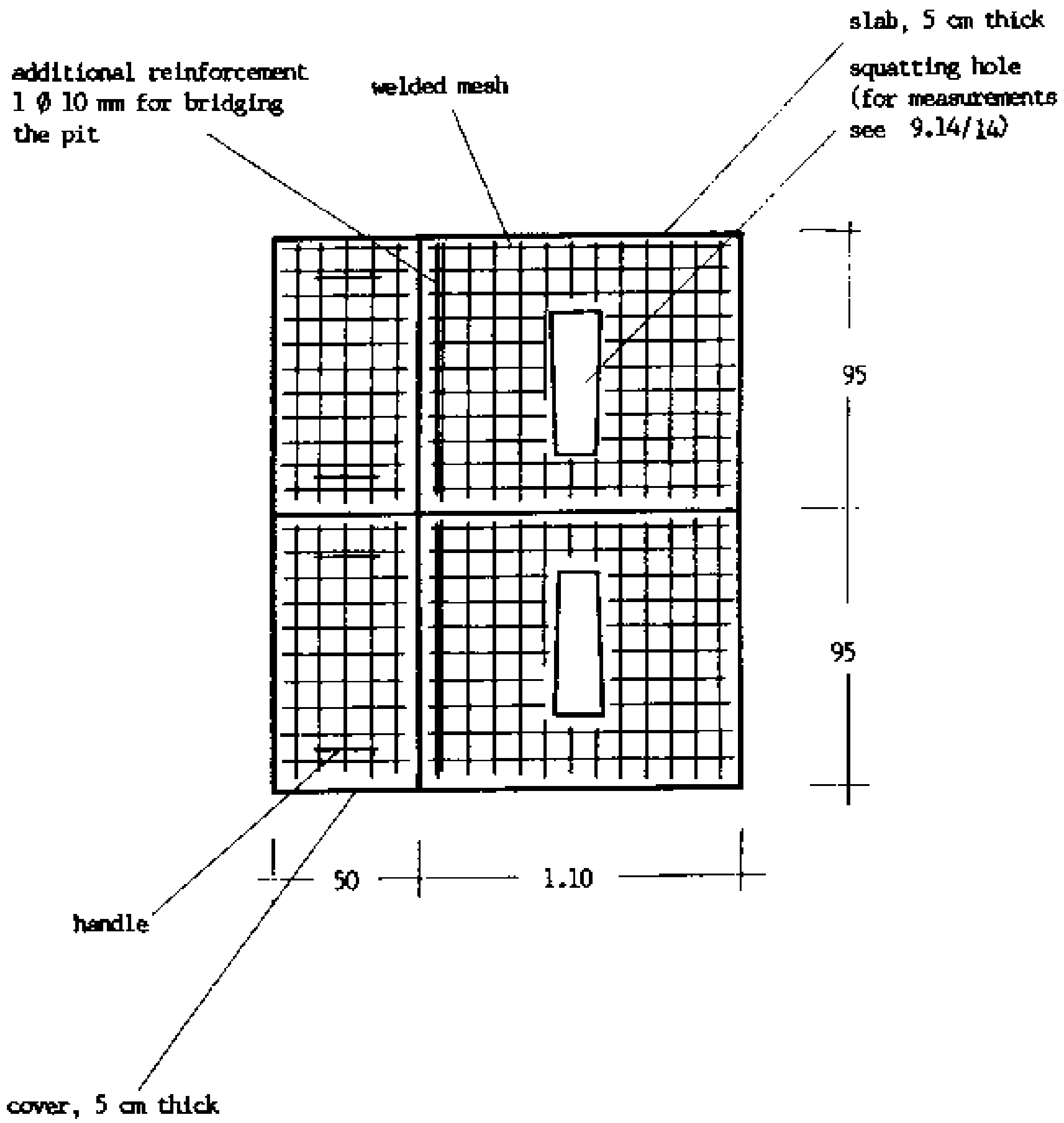
LAYOUT PLAN C–C: SLABS AND COVERS



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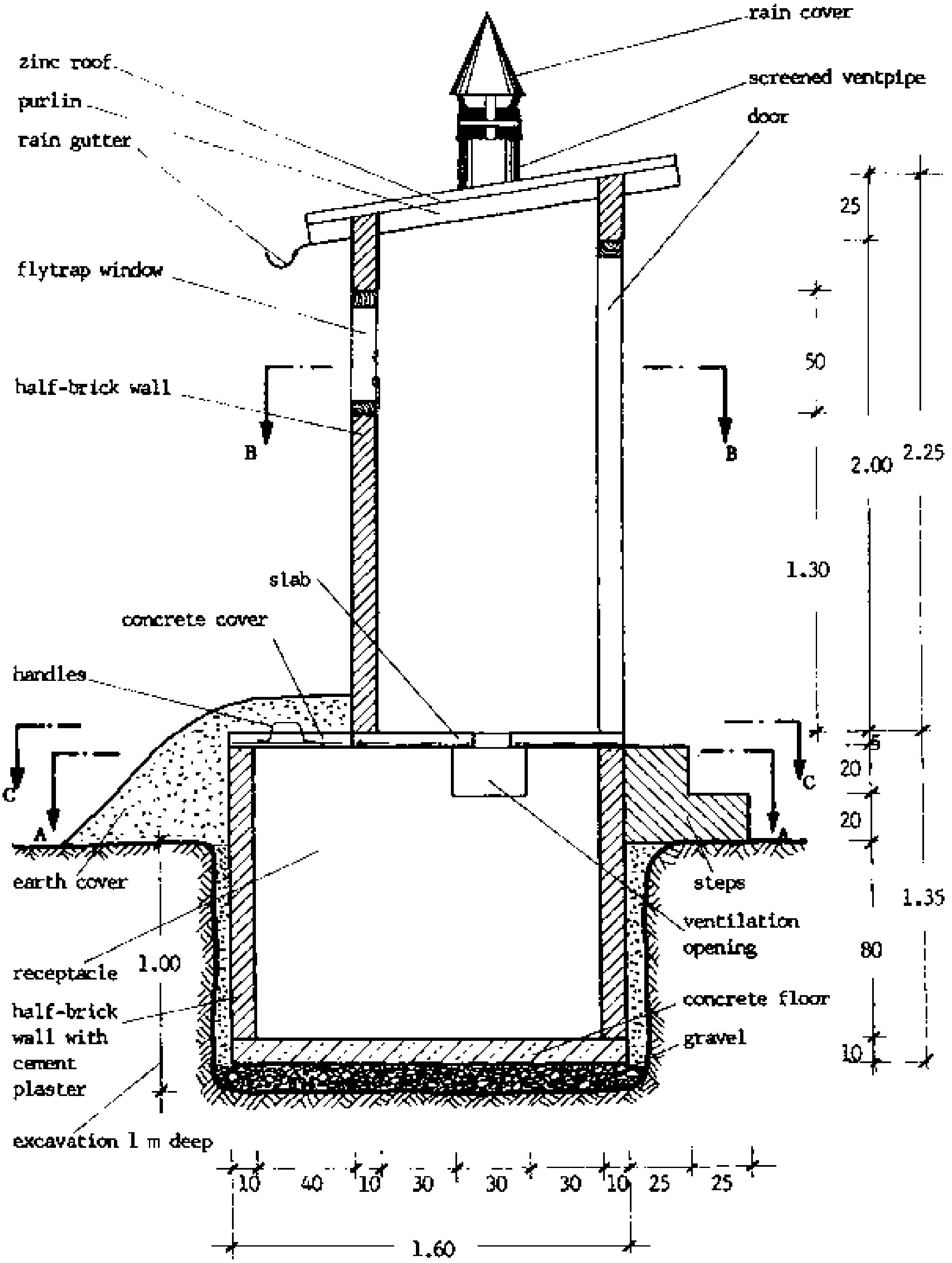
CROSS–SECTION D–D: ACROSS THE BUILDING



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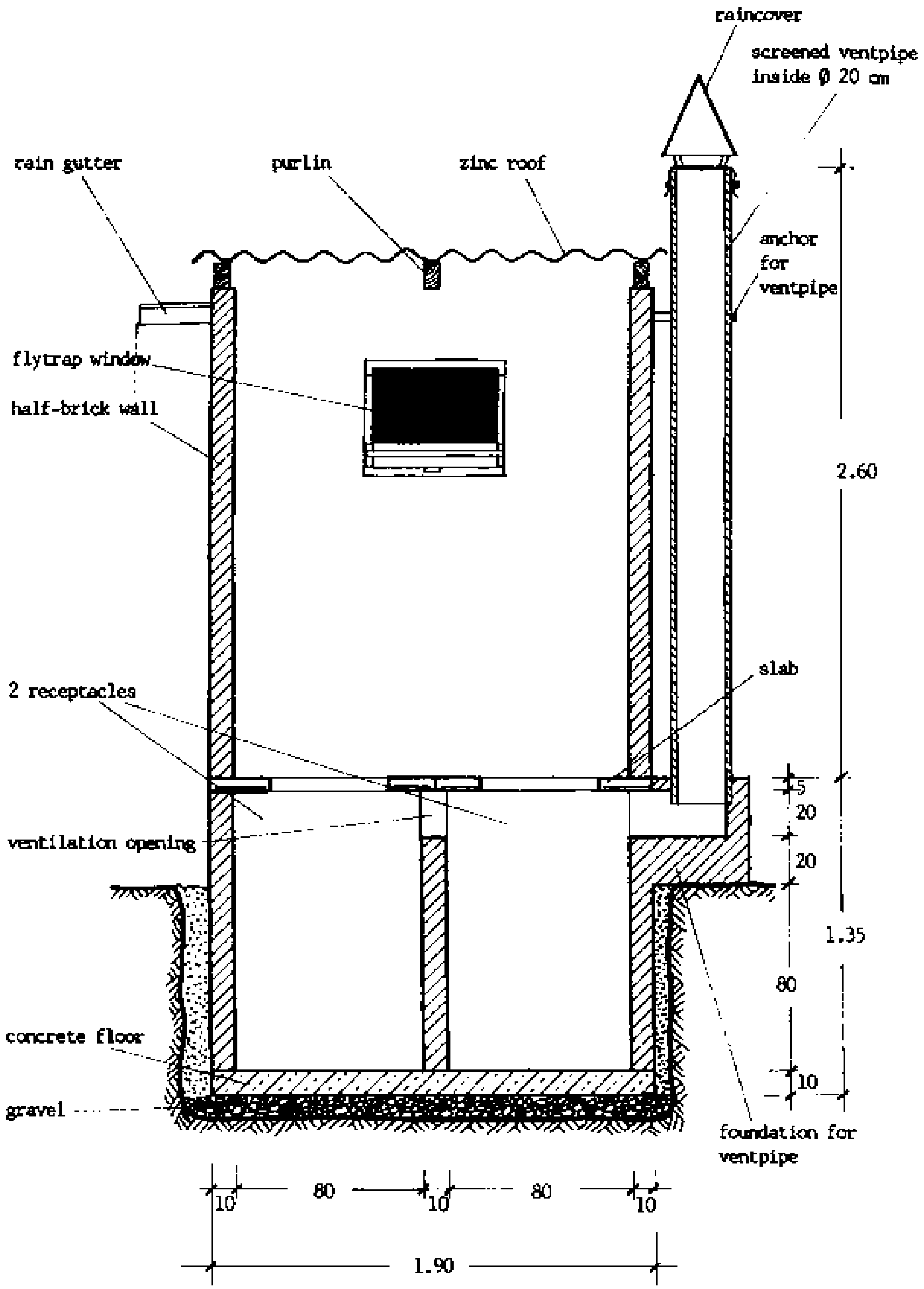
CROSS–SECTION E–E: ALONG THE BUILDING



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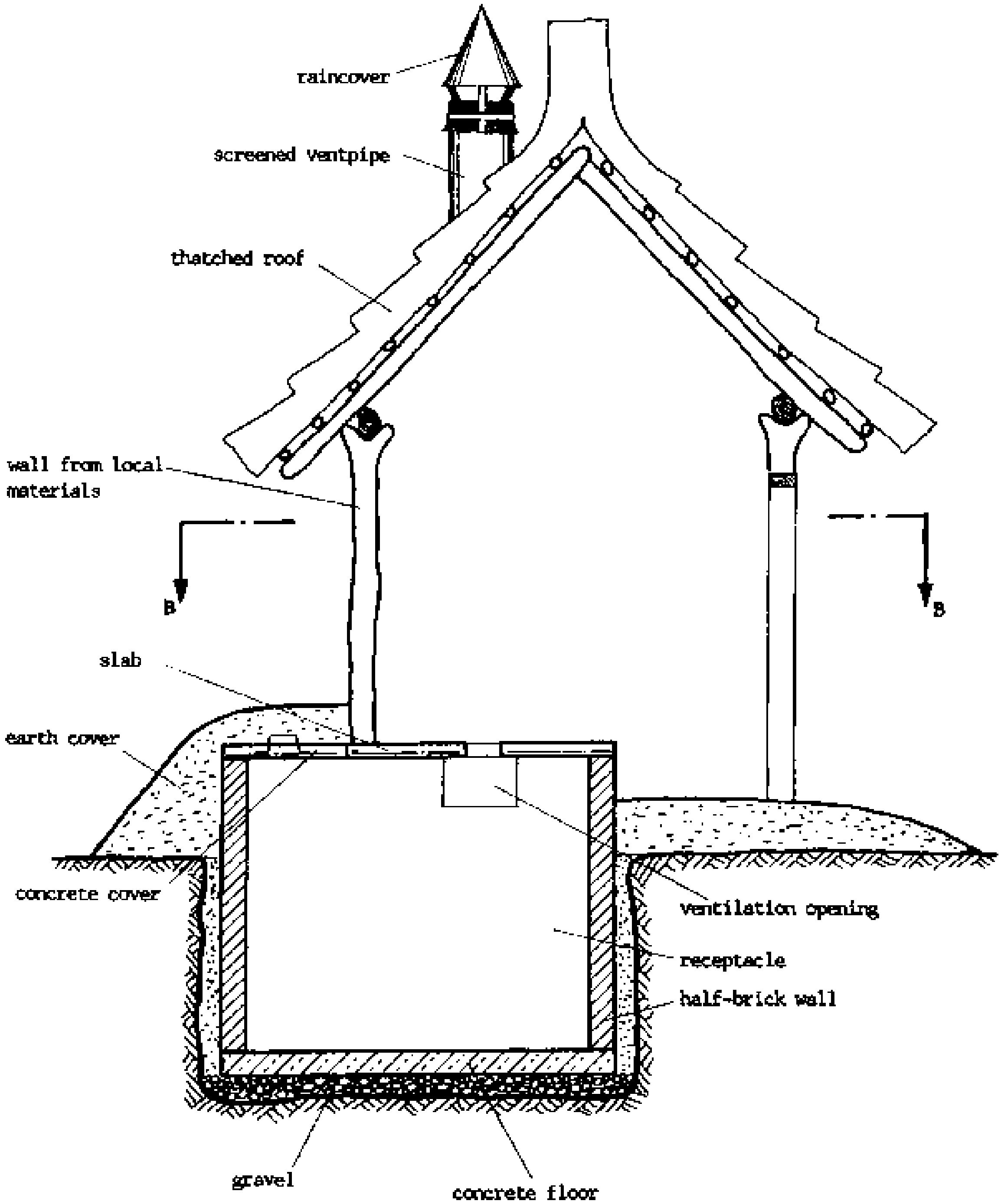
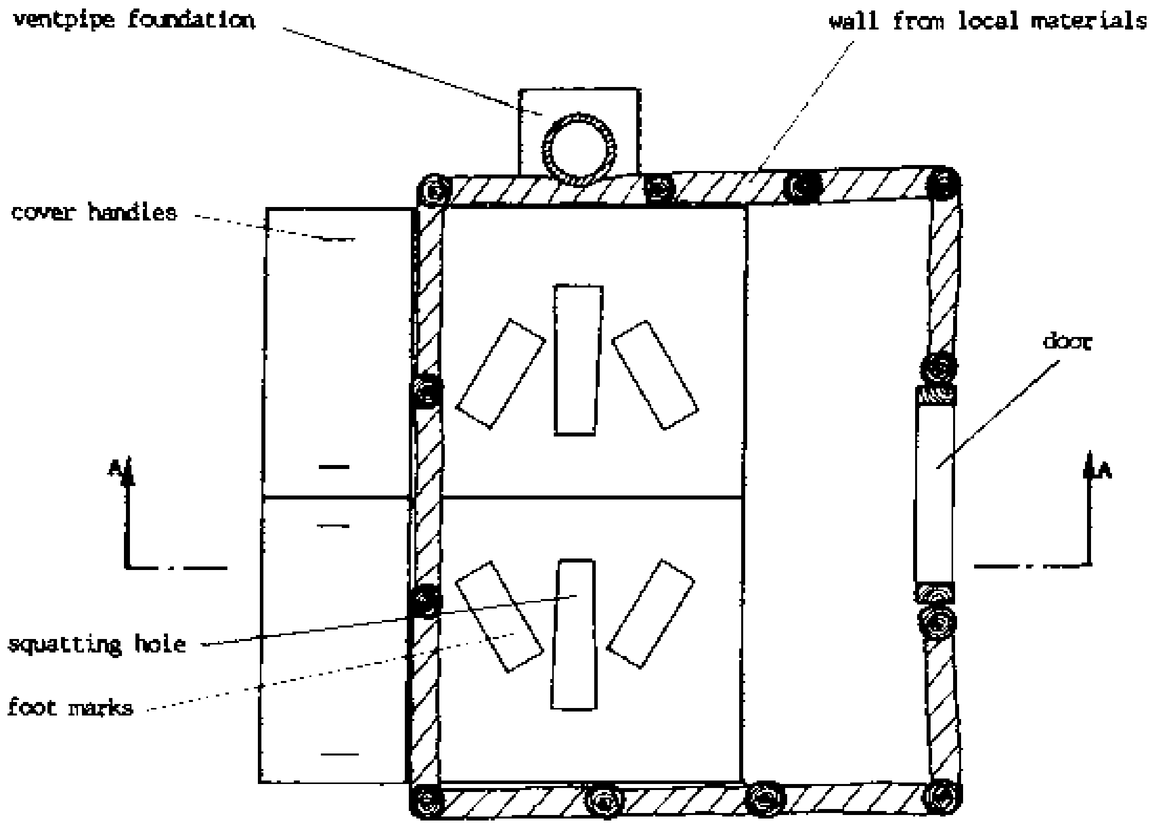
2. Compost Latrine with Local Superstructure

The pit including the slabs is exactly the same as for the compost latrine from permanent materials.

CROSS SECTION A–A



<u>LAYOUT PLAN B–B</u>



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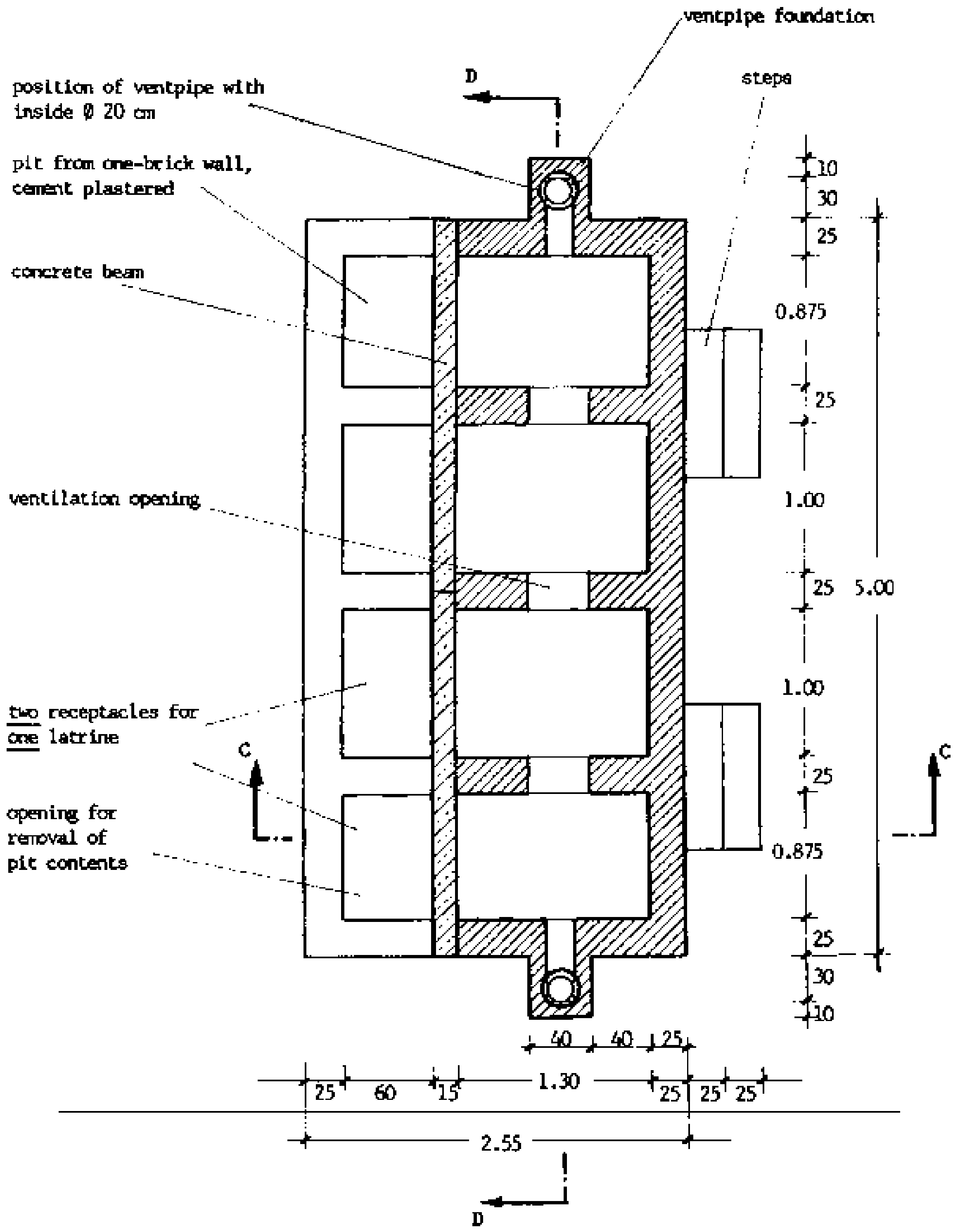
3. Double Compost Latrine for Institutions (Schools, Offices, Clinics, etc.)

The volume of the two pits is 5.1 m^3, the volume of all the four together is 10.2 m^3. All walls are one brick walls (alternatively, the superstructure can be built as half-brick wall). A reinforced concrete beam spans the pit. For more users a triple compost latrine can be built.

Prefabricated Parts

Quant.	Item	Measurements	Remarks
2	concrete beams	15 cm × 20 cm × 2.50 m	reinforcement 2 Ø 10 mm
4	concrete slabs with squatting hole and foot marks	170 cm × 125 cm × 5 cm	reinforcement: welded mesh
4	concrete covers	85 cm × 125 cm × 5 cm	reinforcement: welded mesh; with two handles
2	lids from cement mortar 1:4	53 cm × 20 cm × 5 cm	see 9.14/19
2	wooden lids with handle	53 cm × 20 cm × 2 cm	see 9.14/19
2	ventpipes from ferrocement	inside Ø 20 cm, outside Ø 25 cm, length 2.70 m	reinforcement: chicken wire with screen and rain– cover

LAYOUT PLAN A–A: PITS



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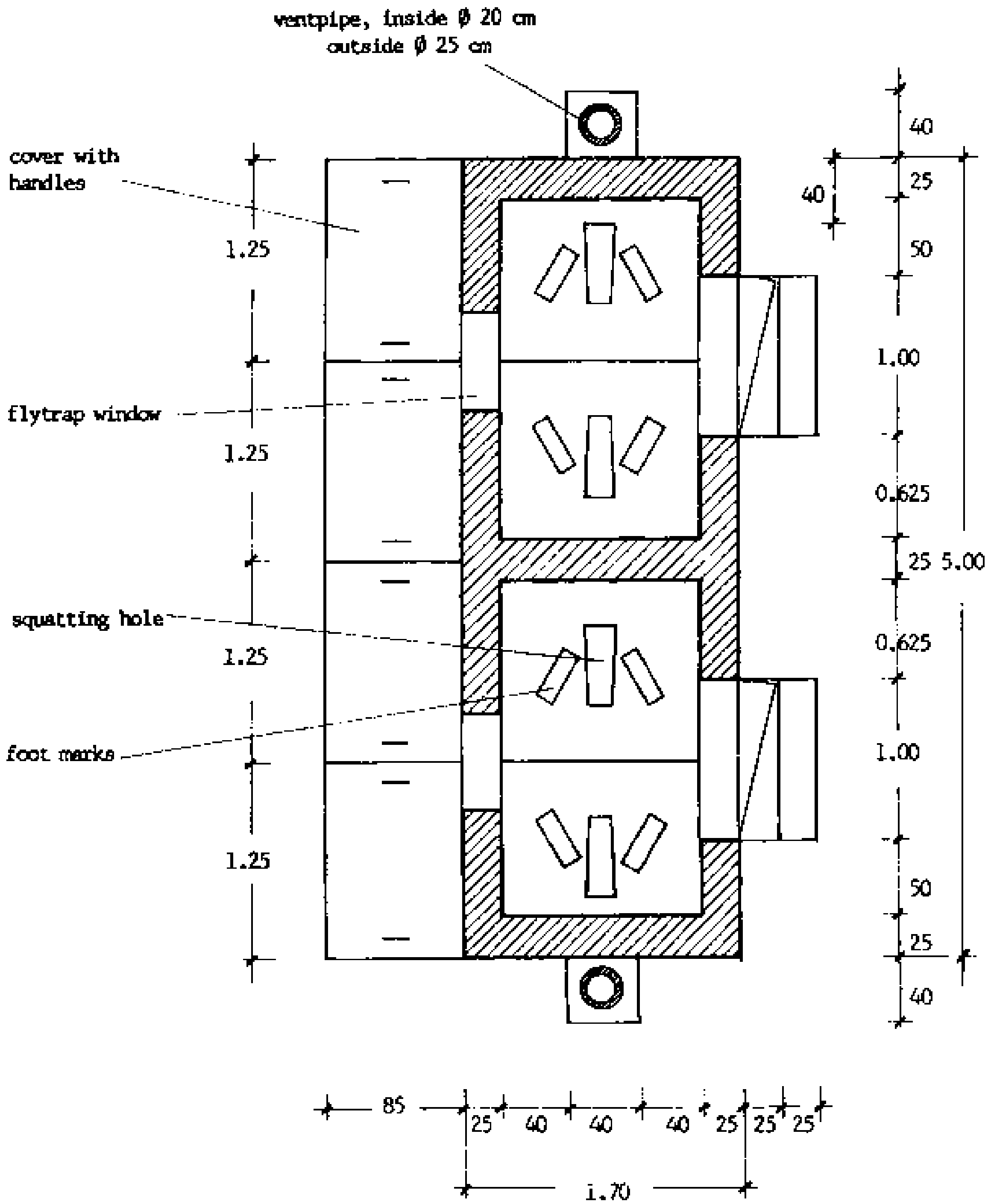
LAYOUT PLAN B–B: SUPERSTRUCTURE



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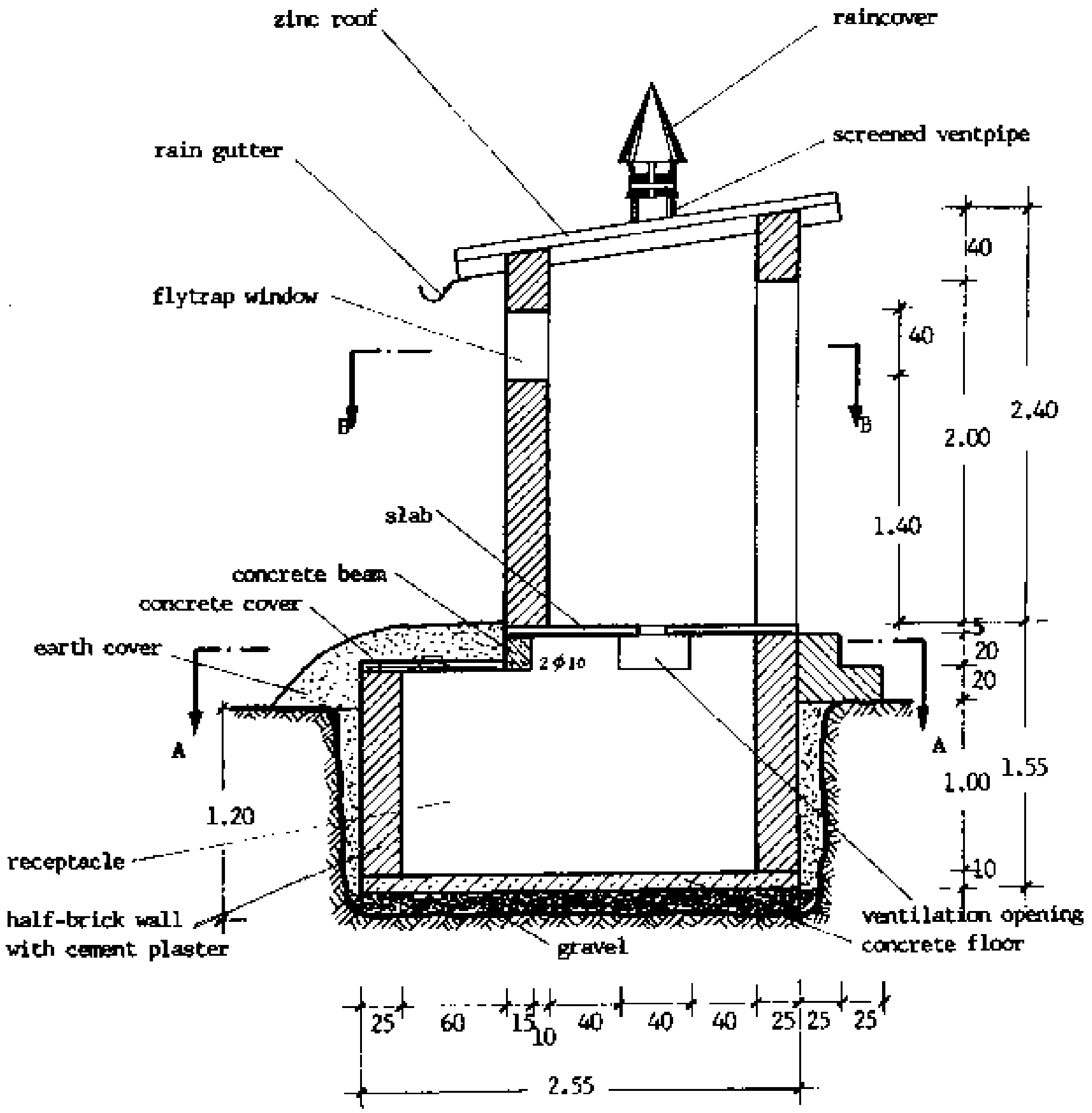
CROSS SECTION C–C: ACROSS THE BUILDING



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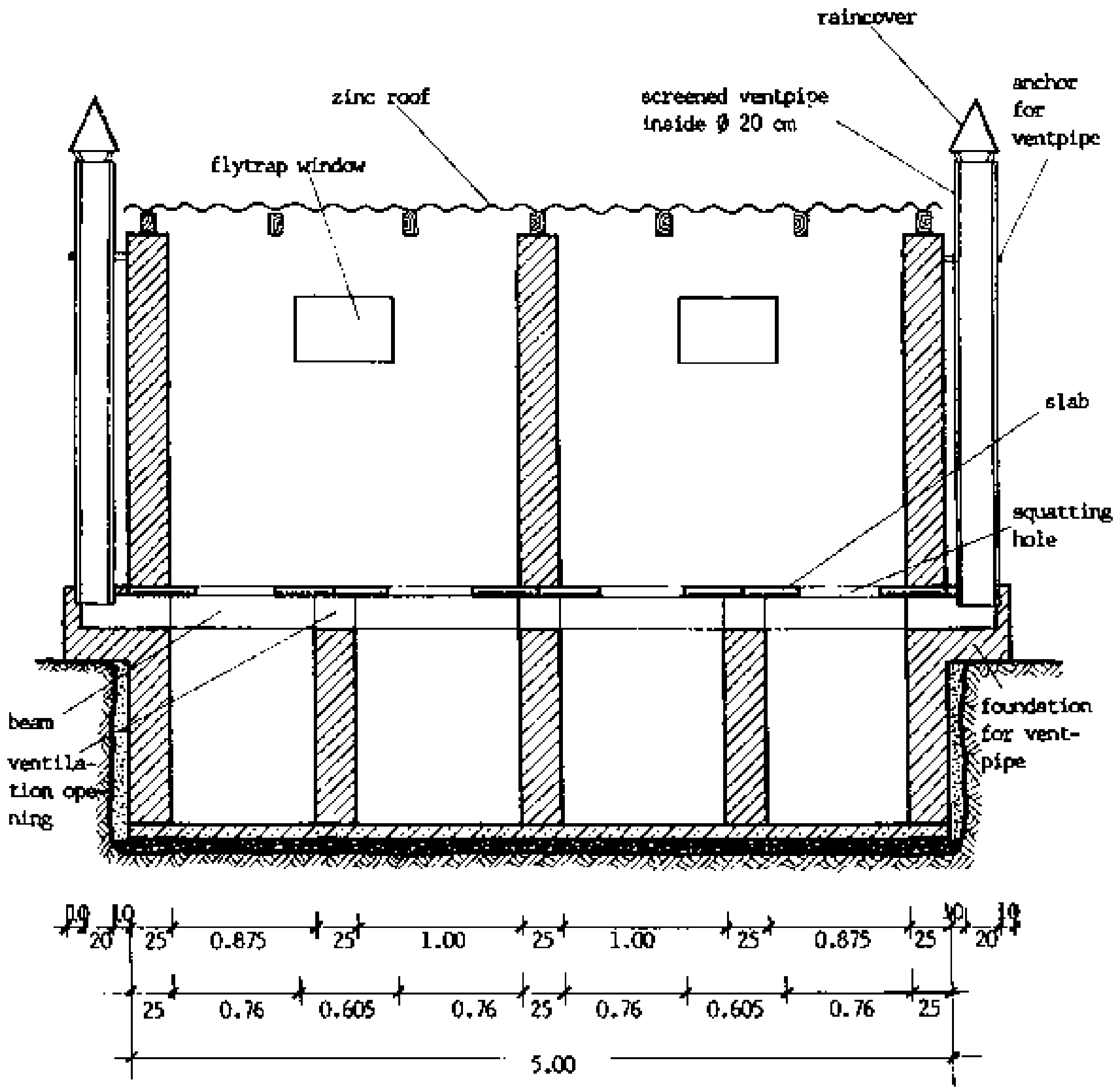
CROSS–SECTION D–D: ALONG THE BUILDING



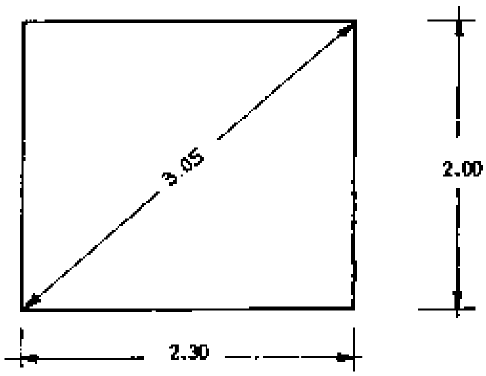
SCALE 1:40

B) <u>Step−by−step Procedures for Construction of a Compost Latrine, Standard Size</u>

1. <u>Pit</u>

Dig a pit 2.00 m broad, 2.30 m wide, and 1.00 m deep, with straight walls (see 6.2, Marking Rectangular Layout Plan)

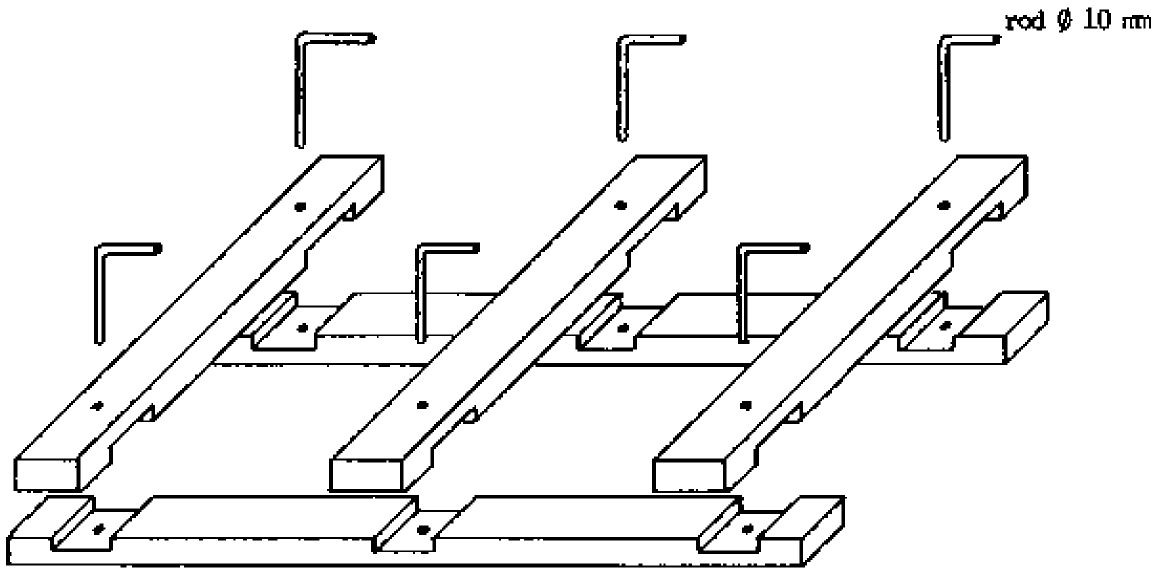
Pit 2.00 × 2.30 × 1.00



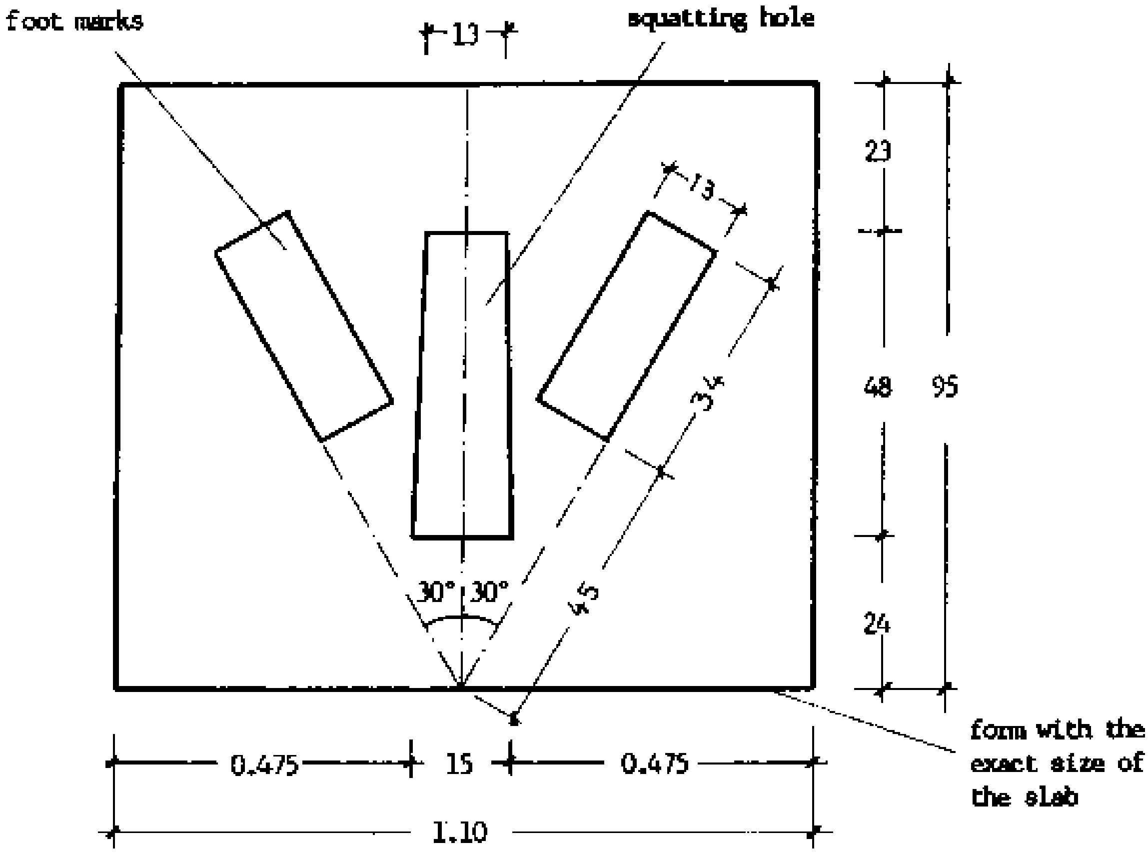
2. <u>Slabs and Covers</u>

– Prepare two sets of wooden frames from timber 2"×4" which can be used for manufacturing many slabs and covers (for measurements see 9.14/15).

EXPLODED DIAGRAM

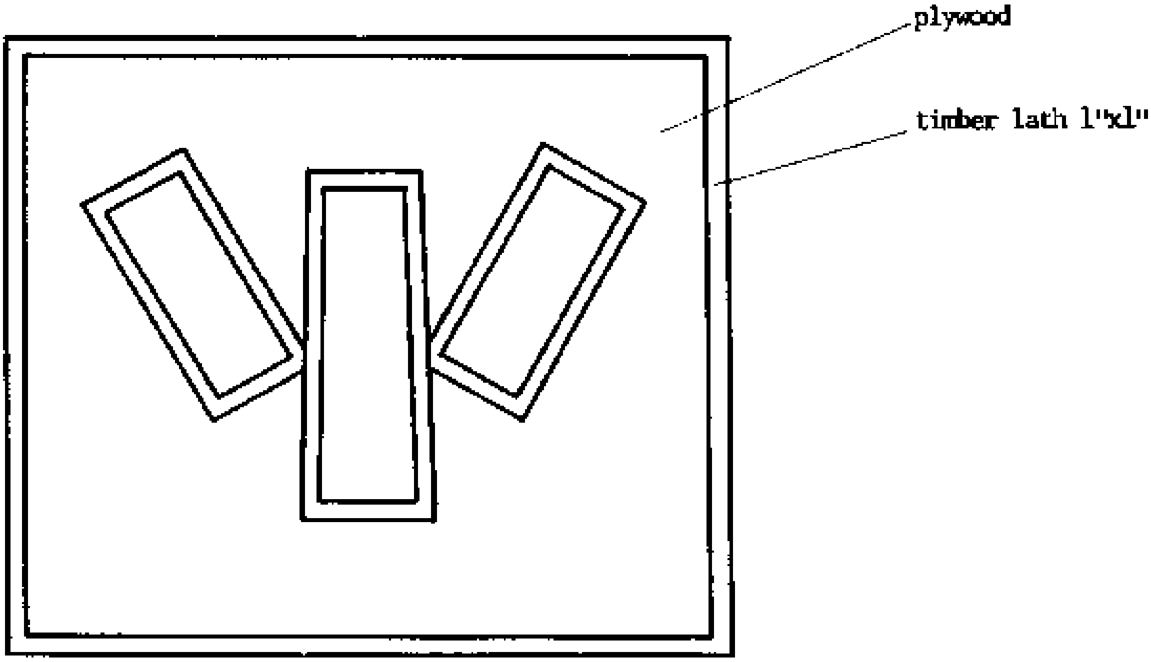


– Prepare a form for the squatting hole and the foot marks. It can be used for manufacturing many slabs. Cut it from plywood, and cut out the places for the squatting hole and the foot marks.



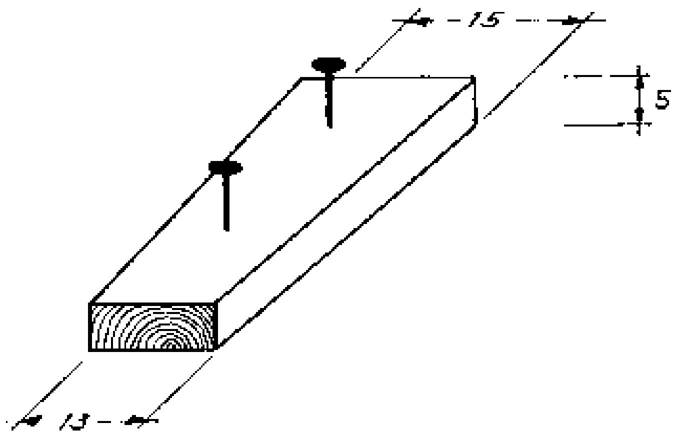
SCALE 1:12.5

– Reinforce all edges with timber 1" × 1" like this:



SCALE 1:12.5

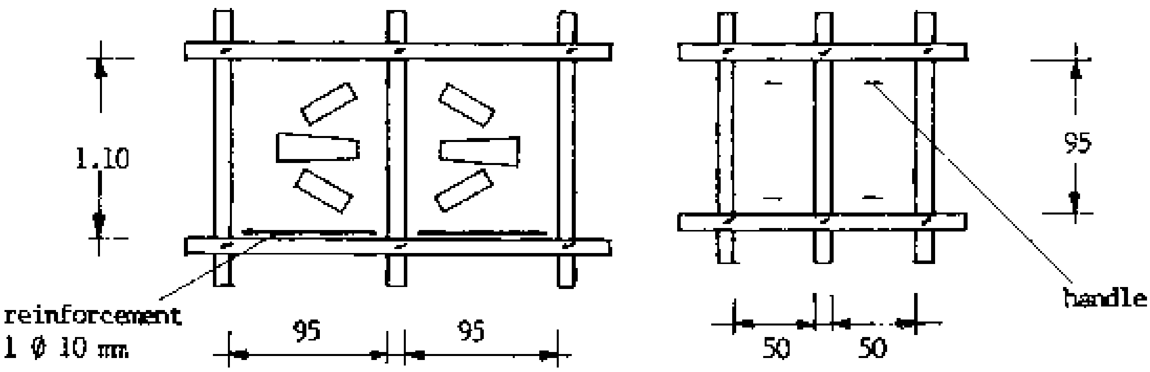
– Prepare a wooden plug for casting the squatting hole which can be used many times. It needs to fit easily into the form for the squatting hole



– Put wet sand on level ground, and level its surface with a straight edge.

– Paint the frame inside with old engine oil.

– Place the frame on the sand. Check the measurements <u>inside</u> and, especially, if both diagonals are equal. Slabs which are not rectangular cause a lot of troubles when placed on the pits later.



– Place the plug for the squatting hole (see drawing above).

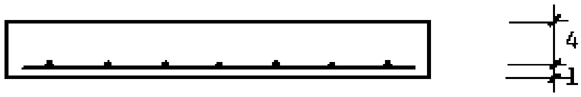
– Cut welded mesh in the size of slabs and covers. Cut out the places for the squatting holes. Cut reinforcement Ø 10 mm for the beam. Cut handles for the covers from reinforcement Ø 6 mm.

– Mix the concrete (mixtures see C).

– Pour concrete 1 cm thick into the frames and compact it well.

– Place the welded mesh, reinforcement Ø 10 mm and handles on top of the concrete (location see above drawing).

– The position of the reinforcement should be like this:



– Pour the rest of the concrete and compact it well.

– Make the top of slabs and covers straight with a straight edge. Make a concrete finish.

– Remove the plug from the squatting hole and apply a finish inside the hole.

– Mark on the slab where you have placed the additional reinforcement Ø 10 mm.

– After an hour, cover the slabs and covers with wet sand and a nylon sheet.

– The frames can be removed after 6 hours.

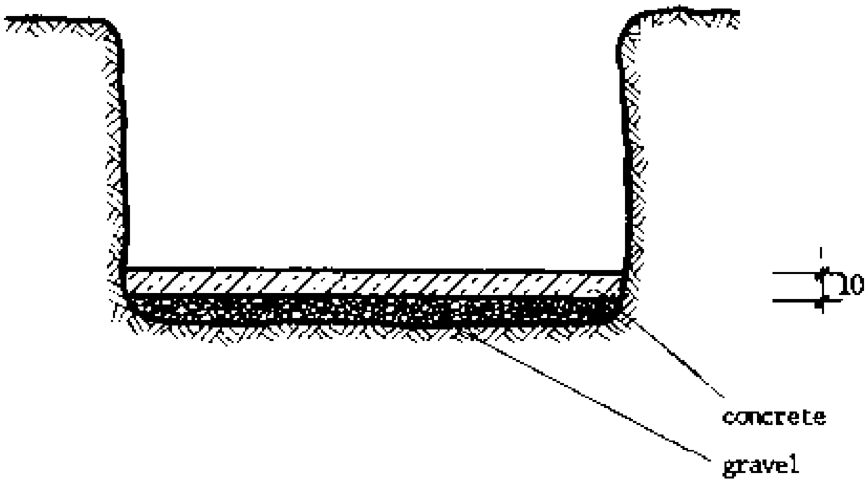
– Keep slabs and covers wet for five days.

– Do not move or lift them before a week.

Slabs and covers can be either manufactured on site or centrally in a workshop. The latter is more economical if many latrines are to be built.

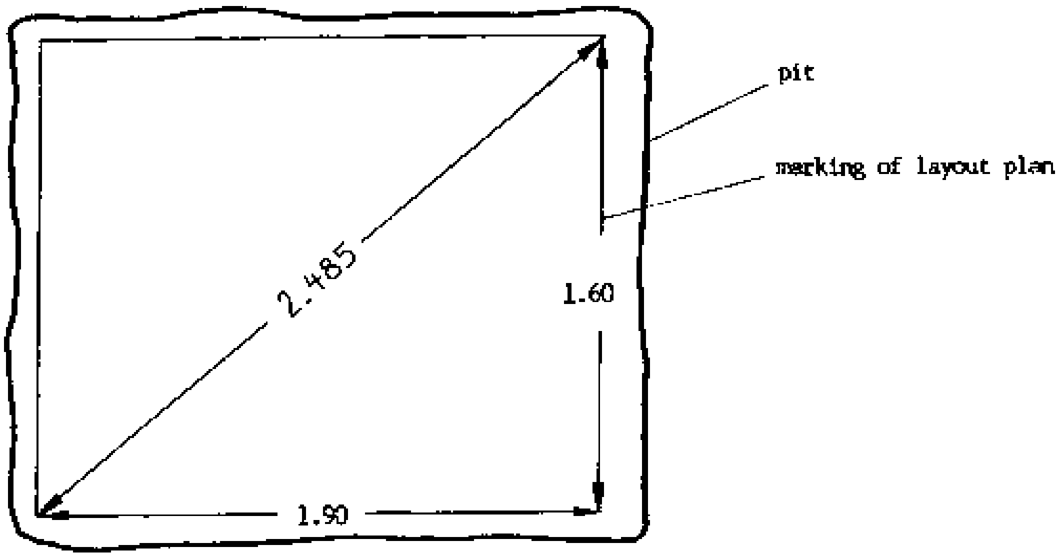
3. Floor

– Put some gravel into the pit and level it.
– Cast a concrete floor 10 cm thick and compact it well.
– Level the top. A concrete finish is not necessary.



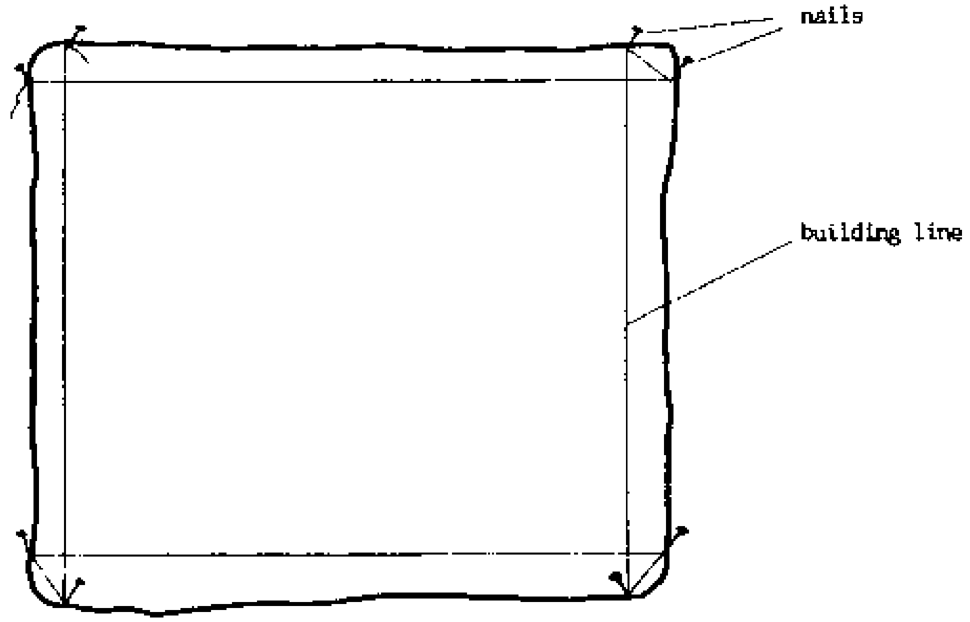
4. Brick Walls

– Mark the layout plan of the pit (outside edge) on the concrete floor (see 6.2, Marking Rectangular Layout Plan).

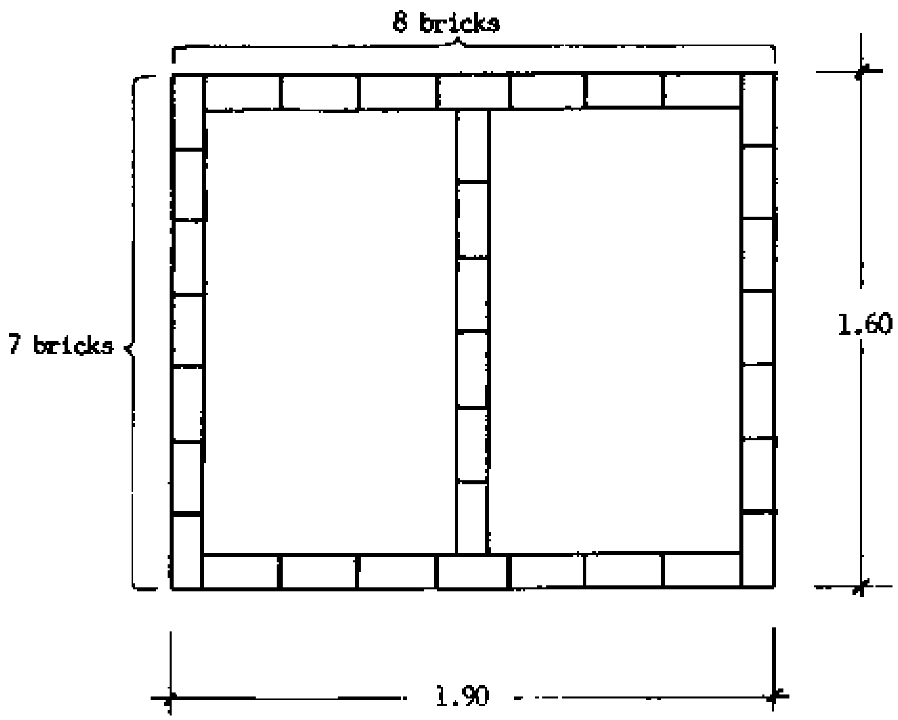


SCALE 1:25

– Span a building line. Check all sides and diagonals.



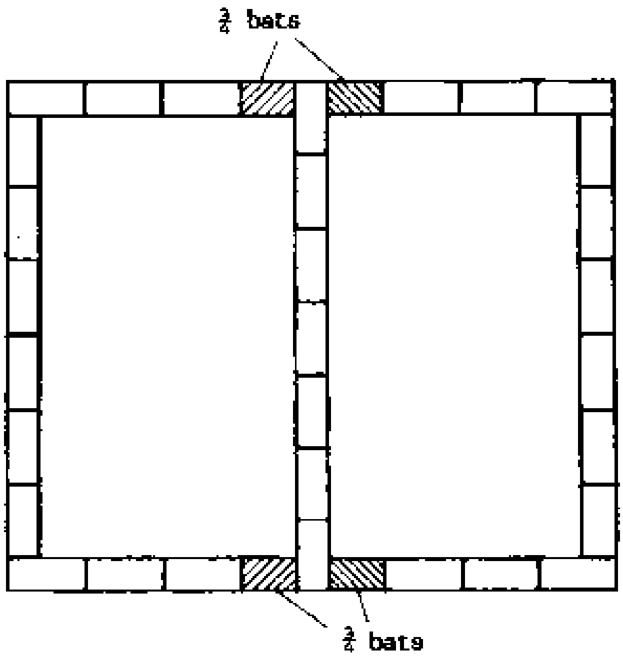
– Build the first course.



8 × 22 cm = 176 cm
8 × 1.75 cm = 14 cm
190 cm

7 × 22 cm = 154 cm
6 × 1 cm = 6 cm
160 cm

– Build the second course.



SCALE 1:25

– Build again the first course and continue building first and second course alternatively.

– Check the measurements and diagonals from time to time; check as well if the walls are vertical.

– Continue to build the walls until about 30–40 cm above ground; however, leave the openings for ventilation and to the ventpipe.

– Build the foundation for the ventpipe.

– For details see also 6.7, Bricklaying.

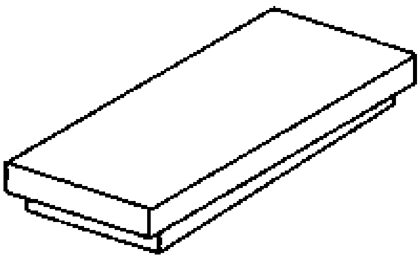
5. Plastering

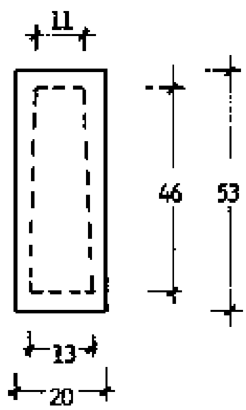
– Plaster the two pits inside with cement mortar (mixture see C).

6. Preparing the Lids

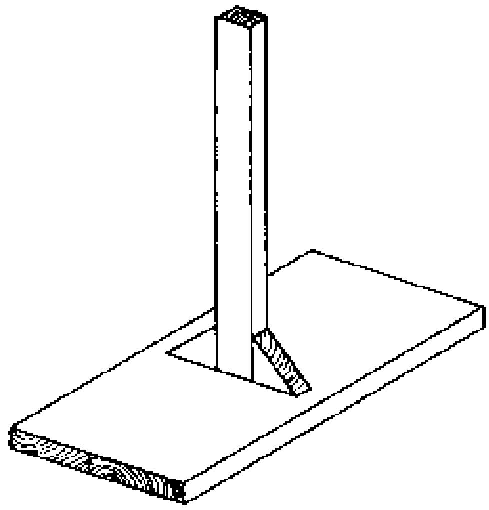
– Make a heavy concrete lid for the squatting hole not to be used.
– Make a wooden lid with handle for the other squatting hole.

Concrete Lid:





Wooden Lid with Handle:



SCALE 1:15

7. Placing the Slabs

– The slabs must have been cured at least for two weeks before you can place them on the pit.

– Place cement mortar on the wall where you place the slabs.

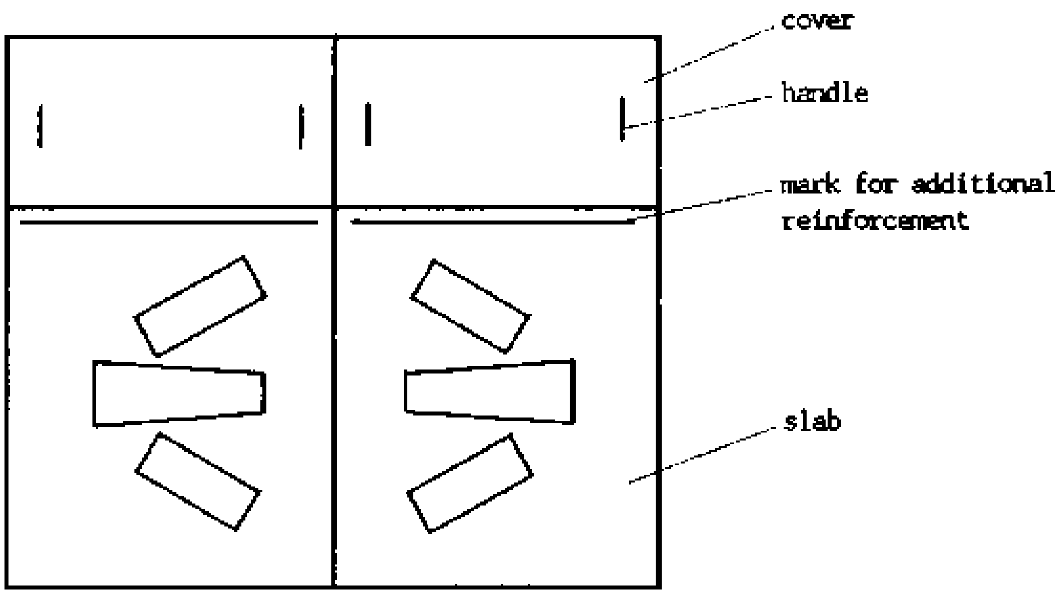
– Place the slabs. The mark for the reinforcement Ø 10 mm must be above the pit, not above the wall. The additional reinforcement Ø 10 mm acts instead of a beam which spans the pit.

– The squatting positions must face each other (see drawing).

– Make sure with the spirit level that the slabs are horizontal. Fill in all cracks with cement mortar.

– Place mud mortar on the wall where you place the covers.

– Place the covers. Fill in all cracks with mud mortar.



8. Superstructure

The superstructure is to be built by the owner. Its construction is conventional building. It can be done with permanent or local materials and shall not be described here.

9. Fixing the Ventpipe

Manufacturing ventpipes is described in 9.15. When the superstructure is completed,

– Fix mosquito wire on top of the ventpipe with wire.

– Fix a small roof on top of the ventpipe against rain.

– Fix the ventpipe in its foundation with cement mortar.

– Connect the ventpipe with the superstructure with an anchor from flat iron or similar.

10. Preparing the Latrine for Handover

–Clean the pits and slabs from mortar and brick rubble. The pit must be dry.

– Prepare the pit for use as described in 9.16.

– Put earth over the covers as an additional seal.

– Put the heavy concrete lid on the squatting hole not to be used first.

– Put the wooden lid on the other squatting hole.

– Place a basket with ashes or sand with a tin, a broom and papers in the latrine.

– Fix the posters for instruction on the wall.

11. Operating Instruction

After the technical work is done, inform the community development staff to conduct an operating instruction for the users of the latrine (see 9.17).

C) Materials Needed for a Compost Latrine, Standard Size, without Superstructure

Work	Cement Buckets	Sand Buckets	Gravel Buckets	Mixture	Bricks	Other Material
slabs	3	8	6	1:2.7:2	–––	1 welded mesh plus reinforcement Ø 10
finish of slabs	1/2	–––	–––	–––	–––	–––
filling under floor	–––	–––	10	–––	–––	–––
floor	3	8	10	(1:3:4)	–––	***
walls	$4\frac{1}{2}$	18	–––	1:4	700	–––
ventpipe foundation	$\frac{1}{2}$	2	–––	1:4	30	–––
plastering	2	12	–––	1:6	–––	–––
fixing slabs and ventpipe	$\frac{1}{2}$	2	–––	1:4	–––	ventpipe mosquito wire

steps	$\frac{1}{2}$	4	–––	1:8	20	–––
contingency	$1\frac{3}{4}$	26			250	
Total	$16\frac{1}{4}$ = 5 bags		50		1000	

1 bag of cement = $3\frac{1}{4}$ buckets; 1 bucket is about 10 litres;
*** in black cotton soil put 2 layers of welded mesh into the floor (see 6.6/11).

9.15. Ventpipes

Some basic information about ventpipes for latrines and a way to manufacture ventpipes locally are compiled here.

A) <u>General Information</u>

A correctly installed and well maintained ventpipe is an improvement for any pit or compost latrine. It has the following functions:

1. It provides ventilation for the pit. The gases produced during composting can escape.

2. It enables the contents of the pit to dry (in a hot climate).

3. It acts as a fly–trap.

In order to serve these purposes, the following conditions must be fulfilled:

1. The ventpipe must have a sufficient diameter, either a smaller diameter with smooth inside surface or a larger diameter with rough inside surface. 10 cm diameter is the minimum for smooth pipes, 15 – 20 cm diameter is better.

2. The ventpipe must be long enough; it should reach higher than the highest point of the roof (to avoid turbulences above the ventpipe).

3. It is an advantage if the ventpipe is dark or black because it will heat up more and, thus, create an upward draft.

4. It should be exposed to sun. The sun will heat it up and create an upward draft.

5. Rain should be prevented from entering the ventpipe by a small cover. There must be sufficient space between the top of the pipe and the cover to allow air to pass (drawing see 9.3/3).

6. The top of the ventpipe must be sealed with mosquito wire to prevent flies from escaping and, thus, kill them. As the gases produced by the composting process are highly corrosive, ordinary mosquito wire gets holes after some time. It is most essential to replace the mosquito wire every 6 to 12 months.

7. The footing of the ventpipe must have no cracks which would allow flies to escape.

A ventpipe with its screen torn is worse than a latrine without a ventpipe. The warm gases escaping from the ventpipe will attract by their smell more flies than without a ventpipe. You can feel the gases with your hand over a ventpipe if the composting process has already begun.

Therefore, you should only install a ventpipe if you or the users are able and ready to maintain it, i.e. to replace the mosquito wire regularly. Otherwise, it is better to have a latrine without a ventpipe. Such a latrine can also function well and be smell−free if sand and ashes are poured into the pit after each use.

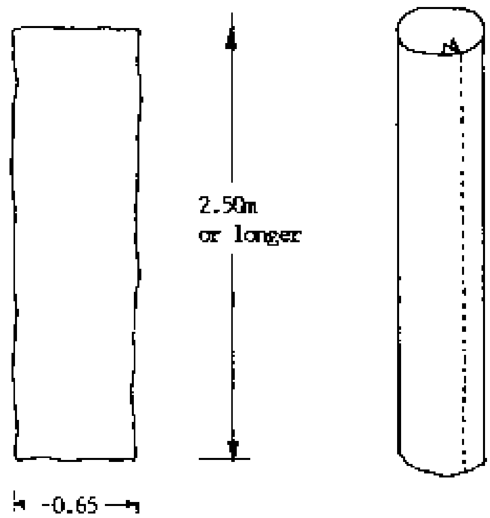
B) Manufacturing Ventpipes Locally

Manufacturing ventpipes locally might be an alternative to industrially produced plastic or metal pipes which can be expensive depending on the logistics facilities of the area. Do not use asbestos cement pipes because mining and production of asbestos cause asbestosis, a deadly lung disease for the workers.

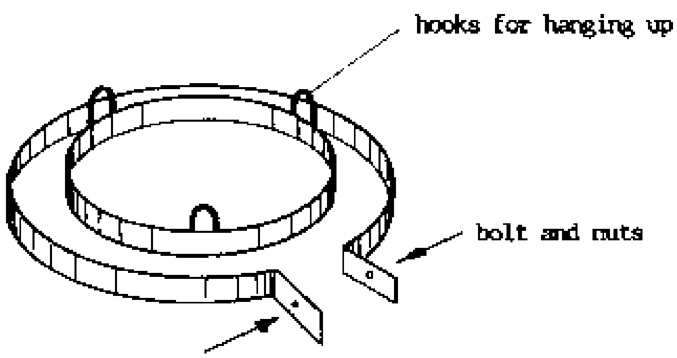
Also, local manufacturing encourages local skills and local trade and provides work and income.

Ventpipes from ferrocement, inside Ø 20 cm, can be produced according to the following steps:

1. Make a mould for the ventpipe by sewing a 0.65 m × 2.50 m sack−cloth to form a sleeve or pipe. Preferably, take good quality sack−cloth or canvas.

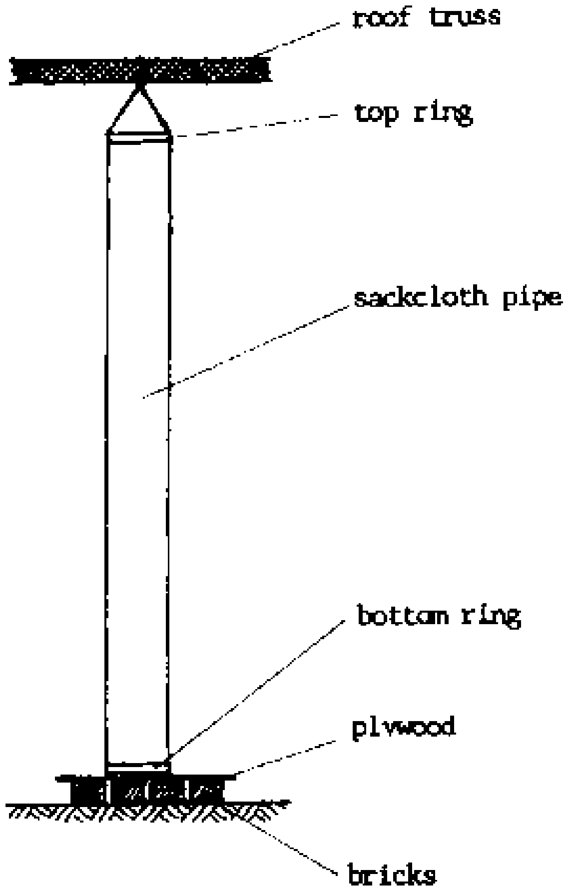


2. Fix a ring of reinforcement Ø 8 mm or a ring of flat iron, 2 cm broad, on top and bottom of the sack−cloth pipe. A double ring from flat iron to be closed by a bolt can be easily fixed and removed again. The sack−cloth is clamped in between the two rings.



3. Dip the sack−cloth pipe into water until it is completely wet.

4. Hang the top of the sack−cloth pipe on the roof truss. Place some bricks and a piece of plywood under its bottom end.



5. Fill the sack–cloth pipe with sand from the top. Take care that it is straight.

6. Mix cement mortar 1:4.

7. Plaster the sack–cloth pipe evenly in a 1 cm thick layer.

8. Cover the pipe with a nylon sheet.

9. Next day wrap one layer of chicken wire around the pipe.

10. Make the pipe wet.

11. Add a second layer of plaster 1 cm thick. Smooth the outside of the pipe.

12. Cover the pipe with a nylon sheet and keep it wet for three days,

13. Wait for seven days.

14. Remove the bricks and the plywood.

15. Remove the sand.

16. Lower the pipe to the ground.

17. Remove one of the rings holding the sackcloth.

18. Pull out the sackcloth pipe.

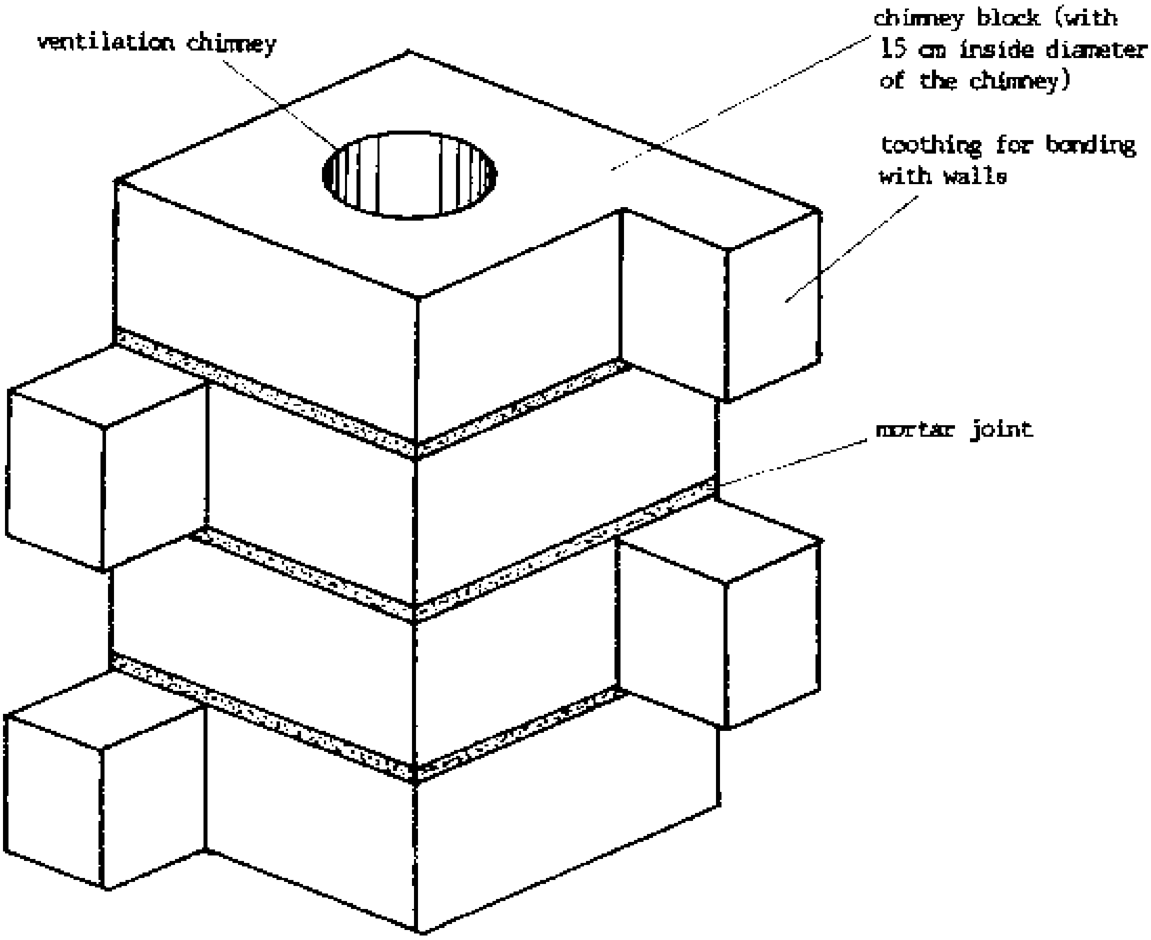
19. Store the pipe carefully and let it cure for another two weeks.

A ventpipe of this kind is quite heavy. The inside is not completely smooth and the pipe might not be completely straight, but the large diameter compensates for that.

The ventpipe is quite strong once installed, but not very resistant to damages during transportation. It should not be transported over long distances by car and should be handled with great care.

The ventpipe can also be manufactured without chicken wire (because of the costs). In that case it must be carefully kept wet for three days and even more care is needed for transportation.

Another alternative to produce ventpipes locally is by making chimney blocks. Square blocks with a round opening are made from a cement/sand mixture or cement/soil mixture and then built as a ventpipe into the corner of the latrine (see bibliography No. 46, April 83).



9.16. Operation and Maintenance of a Compost Latrine

The following operating instructions are primarily intended for a compost latrine. But they are as valid for all sanitation systems without water, like

– pit latrine of local materials,
– VIP (ventilated improved pit latrine),
– children's squatting slab.

Any pit latrine will function better if managed like a compost latrine.

A) <u>Essential Equipment Inside the Latrine</u>

The following items are vital for a well kept latrine. Provide, maintain and replace them when broken:

– basket or any other container with ashes and sand,

– calabash or tin for sprinkling ashes and sand,

– container with waste paper or toilet paper (if people use paper for anal cleaning; when paper is not provided, people might use the leaflets from the wall for their cleaning),

– broom (not to be used elsewhere),

– removable lid for squatting hole,

– permanent, heavy lid for squatting hole of the second receptacle (from concrete or timber with a heavy stone; see 9.14/19),

– instruction leaflets and posters on the wall.

B) <u>Starting–up a Latrine</u>

Before the latrine is used for the first time, put into the receptacle some loosely packed organic residue: grass, weeds, leaves, sawdust, yard sweepings. This absorbs liquids, provides carbon for the composting process, increases the variety of micro–organisms and prevents the pile from becoming too compact. All compost and pit latrines will function better if you start them up like this.

C) <u>Daily Use</u>

The daily use is described in the leaflet following which is to be used for explanation and shall be finally fixed on the wall of the latrine.

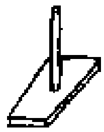
These rules are the core of good latrine keeping. Success of a latrine will depend on keeping them or not. The reasons for these rules are given in chapter 9.13.

It is not easy to introduce these rules in an extended family, an office or school community, etc., using a latrine together.

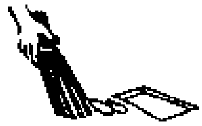
How to use your compost latrine

1. Put some sand or ashes into the hole after each use!

2. Close the lid after each use!

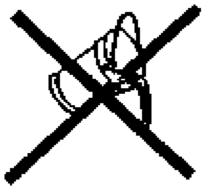


3. If dirty, pour sand over the dirt and sweep it into the hole!



4. Put grass, leaves, sweepings, kitchen left overs into the hole several times a week!

5. **Do not** pour any water into the hole! Clean the latrine dry or with wet grass, but do not rinse it with water!



6. **Do not** put glass, tins or plastic into the hole!

7. **Do not** use desinfectant, old engine oil or DDT!

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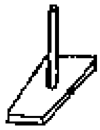
Munuki Water and Sanitation Project
1.1.85/MGG

Sika ita stamilu al bachana min ufraten

1. Kutu ramla walla romat basit fi ufra bad ita stamilu!

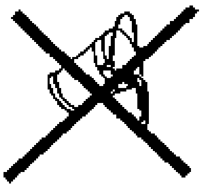
2. Gafulu kuta bad ita stamilu!



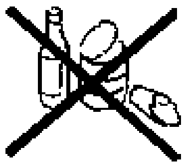
3. Kan waskan kubu ramla fogu wasaka de wa nadifu jua al ufra!

4. Kutu gesh, warsal, wasaka al nadifu min midan taki wa min madba fi ufra kullu usbu!

5. Mata kubu moya fi ufra kullu kullu! Nadifu mustra yabis walla ma gesh al bilu be moya, lakin ma ta kasilu ma moya!



6. Mata kutu gisasat walla hilbat walla listic walla naylon fi al ufra kullu kullu!



7. Mata stamil Dettol walla Finik walla zet mahruk walla DDT kullu kullu!

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1985/MGG

Sudan Council of Churches – Munuki Water and Sanitation Project – Juba, Box 209

To run a compost latrine successfully requires a kind of "administration", such as home administration or school administration. The up–keep needs to be organised, implemented and followed up.

We suggest compiling the work which needs to be done regularly in a check list:

<u>Tasks of the person caring for the latrine</u>:

<u>Daily</u>

– Sweep the latrine.

<u>Once a Week</u>

– Fill the basket with ashes and sand.
– Fill the basket with paper.
– Sweep the walls.
– Put grass and leaves into the latrine.
– Check posters and leaflets.
– Check the contents of the pit whether they are dry.
– Check if the outside lids are well covered with earth.
– Check the screen on the ventpipe.

The following suggestions shall help to ensure a proper up–keep:

1. A person needs to be assigned for overall responsibility concerning the latrine, preferable an elderly person or somebody else with authority. The up–keep of latrines does not work if no one or everybody is responsible. For the daily and weekly up–keep, the different members of the community can be assigned in weekly shifts. The person in overall charge shall remind and encourage the members in their tasks.

2. Repeated instructions of the community or family are necessary, like an operating instruction in the beginning and follow–ups later on. Sit down from time to time with the family/community to discuss problems and remind the members of the correct use.

3. Make use of the psychological effect: A clean place is much less likely to be messed up than a dirty one. Keep your latrine very clean and people will hesitate to mess it up.

4. Keep an eye on who is using the latrine. Usually it is always the same people who notoriously make the latrine dirty. Check the latrine after such a person has used it and, if it is dirty, call her/him back to clean it. Insist that the one causing the dirt will clean it him/herself without quarrelling.

5. Do not use latrine cleaning as a means of punishment or threat for faults of other kind. Do not assign the lowest status people in the family/community for latrine cleaning. This produces the deep impression that latrine cleaning is something shameful and disagreeable. On the contrary, try to explain that by cleaning the latrine we are contributing to the life cycle and preventing diseases, which is a very important and honourable task. Additionally, as Christians we are called to the service of others.

D) Changing Vaults (see leaflet following page)

When the receptacle of a compost latrine is almost full, cover the pile with grass and soil. Close the vault with a heavy lid and start up the second receptacle.

E) Removing Compost

When the second receptacle is nearly full, it is time to remove the compost from the first one. Take off the cover, and remove the contents with hoe and shovel. Do not remove all of it, but leave some to give the new pile a good start. The compost should by now be fairly dry, soil–like and completely odour–free. It is very much reduced in volume. It is not any more dangerous to handle than soil in the garden. Carry the compost to the garden and put it into a shallow trench. Cover it with about 10 cm of topsoil and grow vegetables on top.

F) Number of Users

A compost latrine should not be overloaded; that is used by too many people. 15 to 20 people can use the standard size of compost latrine (volume 2.7 m^3) and will need about one to one and a half years to fill one receptacle. All kitchen waste of the same number of people should be added to provide sufficient carbon.

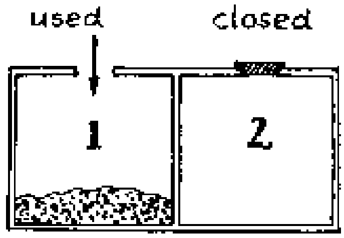
G) Maintenance of the Latrine

Keep the outside covers (those used when emptying the latrine) well covered with earth. Arrange the ground around the latrine so that surface water drains away.

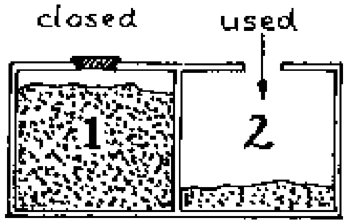
Check the screen on the ventpipe. If it has a hole, replace it. Ordinary mosquito screen might be corroded after 3 months only.

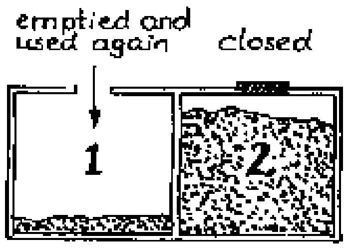
How to empty your compost latrine

1. Use one receptacle only! The other one is closed with a permanent lid.



2. When almost full, put grass and soil into receptacle and close it with the permanent lid! Use the second receptacle!





3. When the second receptacle is almost full, put grass and soil into it and close it with the permanent lid! Empty the first receptacle with hoe and shovel! Use the compost in the garden! Now use again the first receptacle!

4. Continue to use the 2 receptacles alternatively, one at a go!

5. When emptying, repair any cracks with cement mortar and replace the mosquito wire on the ventpipe if corroded!

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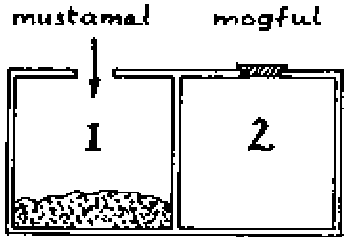
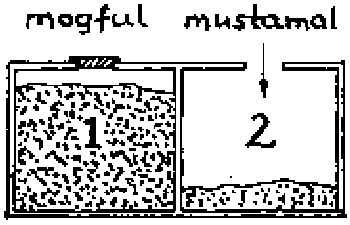
Teriga anina befadi al bachana min ufraten

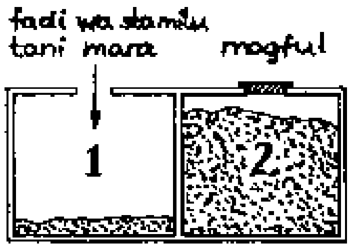
1. Stamil safa wahid bas ! Tani da yakun magful tamam.



2. Kan gerib malyan kutu gesh wa torab fi al ufra wa gafulu tamam! Stamil al ufra tani de !



3. Kan ufra tani gerib malyan, kutu gesh wa torab fogu wa gafulu tamam ! Fadi al ufra nimra wahid be toria wa korek ! Stamil tin al kwais da fi jenena betak ! Hassa raja fi ufra nimra wahid !



4. Stamir stamilu al ufraten be dor !

5. Assa ita be fadi , salau mahalat moksurin be muna sement wa salau al numulia fog al masura kan karabu!

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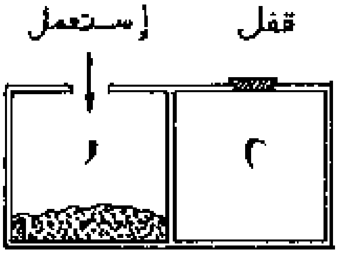
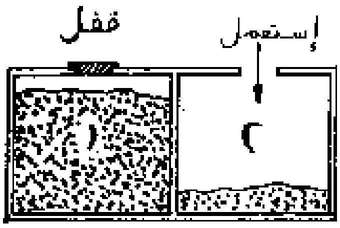
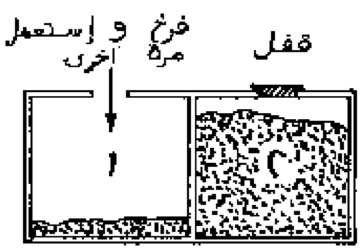
كيف تتفرغ مراحيضك



١ استعمل واحد حفرة فقط و
تقفل حفرة الثانية بالغطاء ثابتة



٢ وإذا ملى الحفرة الاول ضع القش
و التراب على الغطاء ثابتة و
استعمل الحفرة الثانية.



٣ وإذا ملى الحفرة الثانية وضع
القش و التراب عليها و اقفلها ثم
اخرج البراز بستعمال الجاروف و
بعد إخراج البراز أدفنها فى المزرعة
الاخضروات و الات إستعمل الحفرة
الأول.

٤ وتستمر هزة الطريقة بعد ملى كل حفرة حتى
حين أخرى.

٥ إذا تريد أن تفرغ صلح الاماكن المكسورة
بتسعمال السمنت و الرمل ثم النملية على
ماسورة التهوية.

مجمع الكنائس في السودان، جوبا، ص.ب ٢.٩
مشروع منوكي للإصحاح و الماء

1985/MGG

Sudan Council of Churches – Munuki Water and Sanitation Project – Juba, Box 209

H) Rehabilitation of a Compost Latrine

A well kept compost latrine is odour–free and without flies. But what to do if the slab looks like a "map", is full of urine and faeces, with hundreds of flies swirling around, and the pit is like a smelly pool??? Such a latrine needs a general rehabilitation.

1. Procedure

– Scratch all faeces from the slab with sticks into the hole.

– Pour lots of sand and ashes over the wet slab and let it soak.

– Brush the sand into the pit and repeat several times.

– Pour earth, sand and ashes into the pit until no water can be seen anymore and the contents are wet, but not soaked. You might need quite a lot of material for that.

– Pour grass, leaves and especially ashes in plenty into the pit. The contents most likely have too much urine and not enough carbon.

– Clean the inside of the latrine including walls.

– Rub the slab with wet grass or wet sponge and throw it into the pit. Do not rinse the slab with water.

– Pour ashes over it and sweep them in.

– Replace or provide baskets with sand and ashes, paper, broom, lid, etc.

– Check the outside of the latrine for eventual necessary maintenance.

– Seriously advise the users for future use.

If such a rehabilitation is done in time, the pile can still decompose reasonably. If you have to empty a compost pit and the contents are not decomposed but a cesspool, it will be very unpleasant to empty it (by hand or desludging truck).

Learn from experience and keep the latrine better.

Do not blame the compost latrine, but the people who failed to teach and implement the proper up–keep.

2. Example for a Rehabilitation of a Compost Latrine in an Institution (School or Office)

The following detailed action plan is advisable if we want durable improvement. For compost latrines in private homes the rehabilitation process is to be simplified but keeping to the same basic steps.

– Form a group to work on this task.

– Contact the persons responsible for the compost latrine(s) and ask for permission and support for the action.

– Prepare an "action plan".

– Develop a questionnaire.

– Test the questionnaire.

– Prepare and duplicate the final questionnaire.

– Conduct interviews with the users.

– Inspect the compost latrine and write a small report.

– Evaluate interviews and inspection.

– Prepare users' meeting about problems.

– Conduct the meeting with the aim of a decision about how to manage the compost latrine(s) in future.

– Do the practical rehabilitation including cleaning, making the pits dry, and providing missing equipment.

– Prepare operating instruction with drama, poster and health education.

– Conduct operating instruction.

– Handover the compost latrine(s) with the keys to the people in charge.

– Follow up the compost latrine regularly for eventual problems.

Guidelines for conducting the interview:

– Introduce yourself.

– Ask if the time is suitable.

– Explain purpose of interview (which is: gathering information about compost latrines in general, gathering information for improving the compost latrines on the SCC compound).

– Ask if the person is ready for the interview.

– Ask the questions and fill the questionnaire. Make sure that the person has understood the question properly. Do not comment on the answers. Note down the answers also if they are wrong.

– Ask if you can note down the name of the person. If not, note down only male or female.

– Hand out the anonymous questionnaire. Ask for it to be filled in and thrown into the closed box.

– Thank for the interview.

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INTERVIEW OF COMPOST LATRINE USERS ON THE SCC COMPOUND

QUESTIONNAIRE

1– Did you hear about compost latrines? yes/no

2. Do you know what a compost latrine is? yes/no

3. How many pits does a compost latrine have ....

4. Why does a compost latrine have two pits?

....
....
....

5. What happens with the contents of a compost latrine?

....
....
....

6. Why do we need to put ashes or sand into the compost latrine after defaecation?

....
....
....

7. Why must the squatting hole always be covered by the lid?

....
....
....

8. Do you like compost latrines? yes/no

Why?...
....
....

9. Do you see any difference between the left and the right compost latrine on the SCC compound? yes/no

10. Are there any problems with the compost latrine on the right side yes/no

Which problems?...
....

Is the latrine dirty? yes/no

11. What do you think are the reasons for these problems?

....
....

12. Are there any problems with the compost latrine on the left side? yes/no

Which problems?...
....

Is the latrine dirty? yes/no

13. What do you think are the reasons for these problems?

....
....

14. How do you think these problems could be solved?

....
....
....
....

15. Are you ready to attend a meeting about the latrine problem? yes/no

16. Can your department contribute regularly money for the latrine up−keep? yes/no

17. Are you ready to participate personally in the latrine cleaning in shifts? yes/no

only if...
....

18. Are you ready to attend an information meeting for the users? yes/no

19. Would your department like to take over responsibility for the care of one of the compost latrines? yes/no

20. Which of these suggestions No. 15−19 would you prefer? No.......

21. Do you have any further comments or suggestions?

....
....
....
....
....
....
....

22. Are you ready to give

your name:..

title:...

department:..

male/female

Date of Interview........................ Name of Interviewer:..

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GATHERING INFORMATION ABOUT COMPOST LATRINES ON THE SCC COMPOUND

QUESTIONNAIRE

Please kindly answer the following questions. They are necessary for gathering information about the sanitation situation on the SCC compound. Make a cross at the correct answer. You can cross several possible answers. Do not write your name on the questionnaire. Please, throw the filled questionnaire into the closed box in the Munuki office. Thanks.

1. Are you

0 male
0 female

2. Where do you go for a long call?

0 outside the SCC compound into the bush
0 to the flush latrine (WC) near the dispensary
0 to the flush latrine (WC) in one of the guest house rooms
0 to the compost latrine on the left side
0 to the compost latrine on the right side
0 at home

3. Where do you go for a short call?

0 outside the SCC compound into the bush
0 at the fence
0 in the bathroom behind the generator
0 to the flush latrine (WC) near the dispensary
0 to the flush latrine (WC) in one of the guest house rooms
0 to the compost latrine on the left side
0 to the compost latrine on the right side
0 at home

******

9.17. Operating Instruction for Compost Latrines

For all compost latrines built, an operating instruction is conducted for the users. The most important point is not just to have a latrine building, but to use it properly and keep it clean. Otherwise, it will be worse than defaecation in the open and not only become a nuisance, but a danger to health as well.

Therefore, the operating instruction is aimed at giving the future user an idea about what they can do to keep and maintain the latrine properly to avoid problems. It is conducted at the place of the latrine with all members of the household or institution who are going to use the latrine.

The methods used are demonstration, drama, posters, model, leaflets, flip−chart, songs, depending on the audience and the time available (see 4.26 to 4.29).

The topics covered are as follows:

– Why do we need a latrine?

– What is a compost latrine?

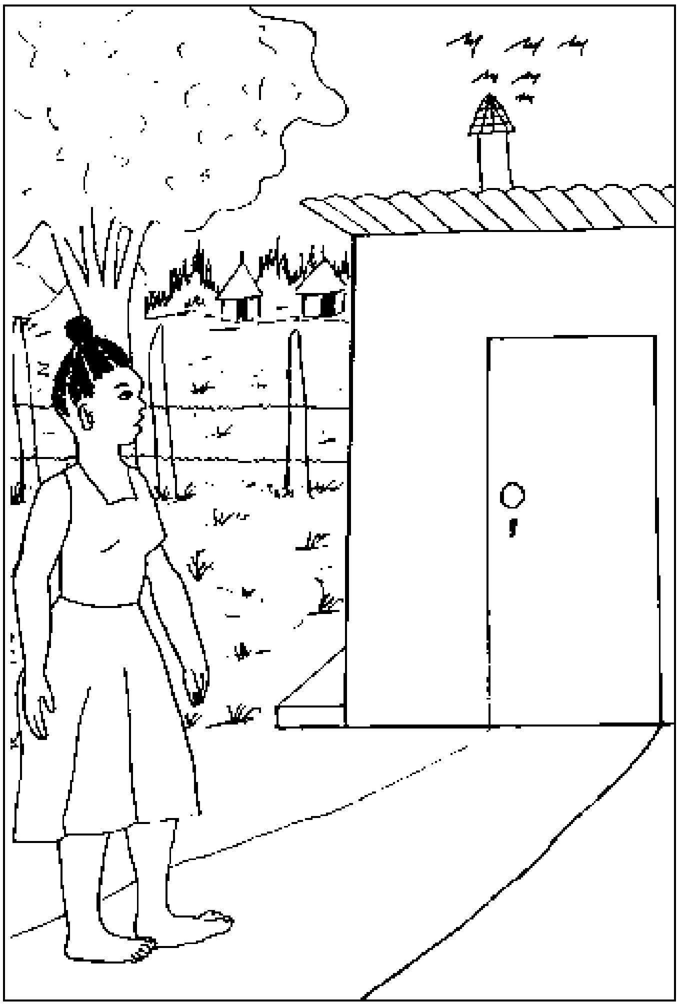
– How do we use a compost latrine?

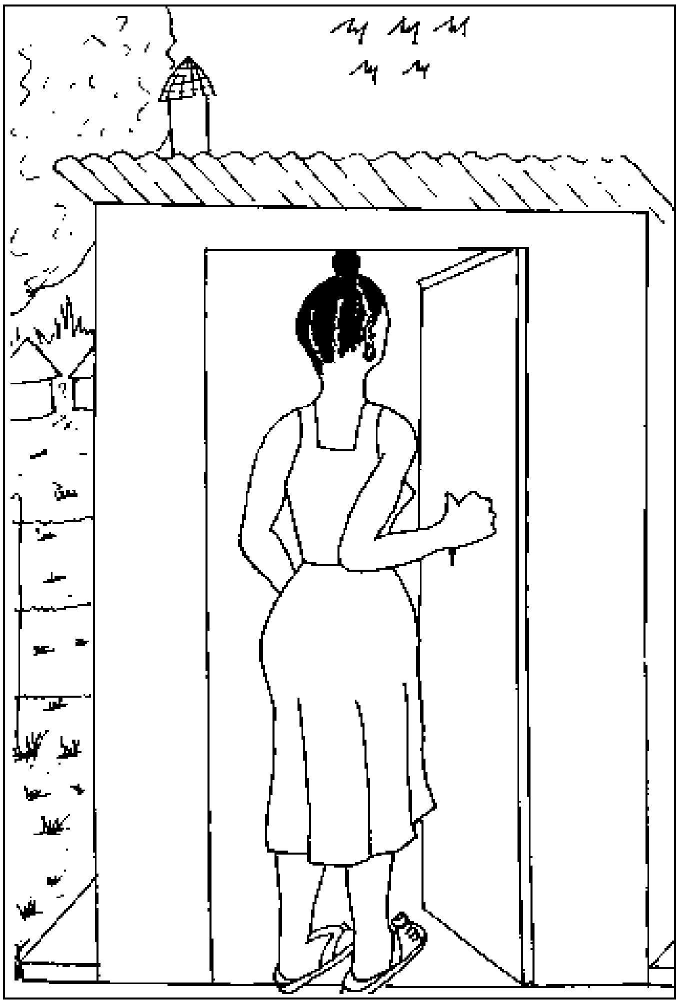
  * every day (see poster series attached)
  * when full (see poster series attached)

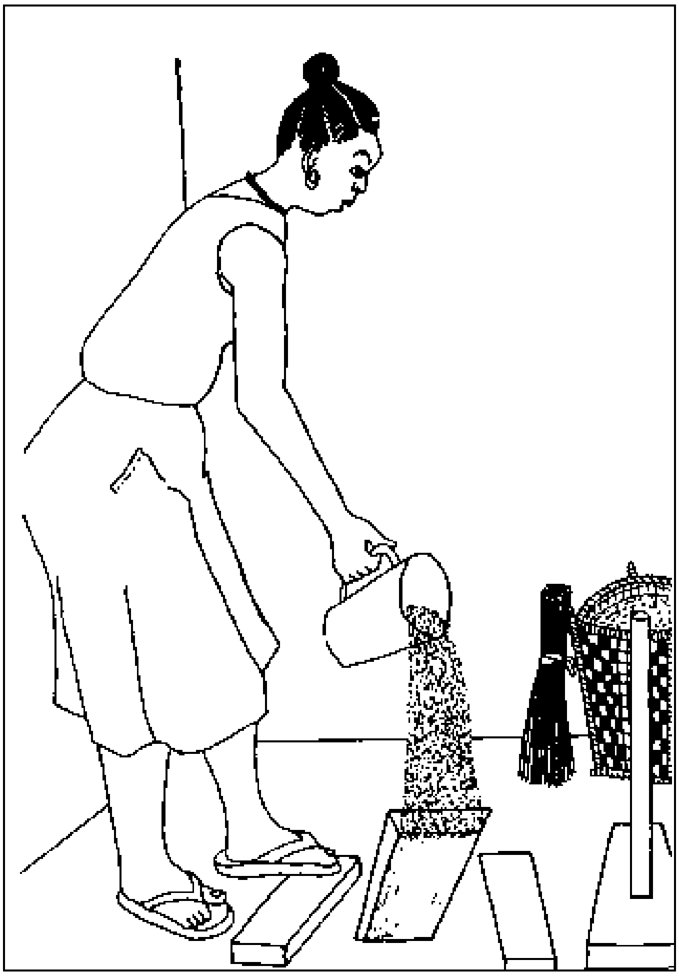
– What else do we need to pay attention to?

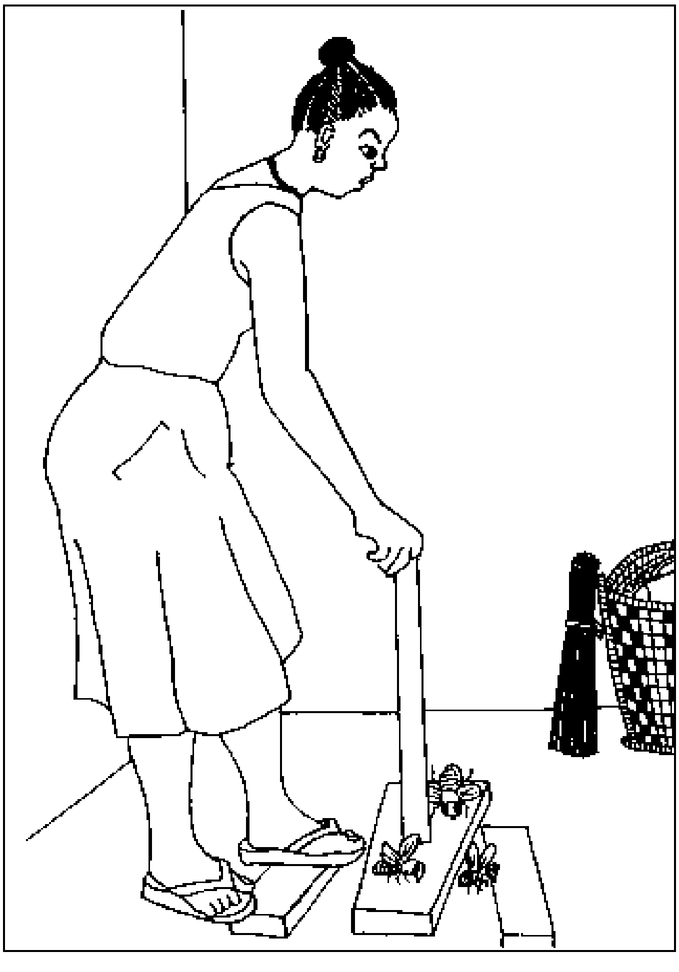
* Who is responsible for taking care?
* What to do if there are problems?

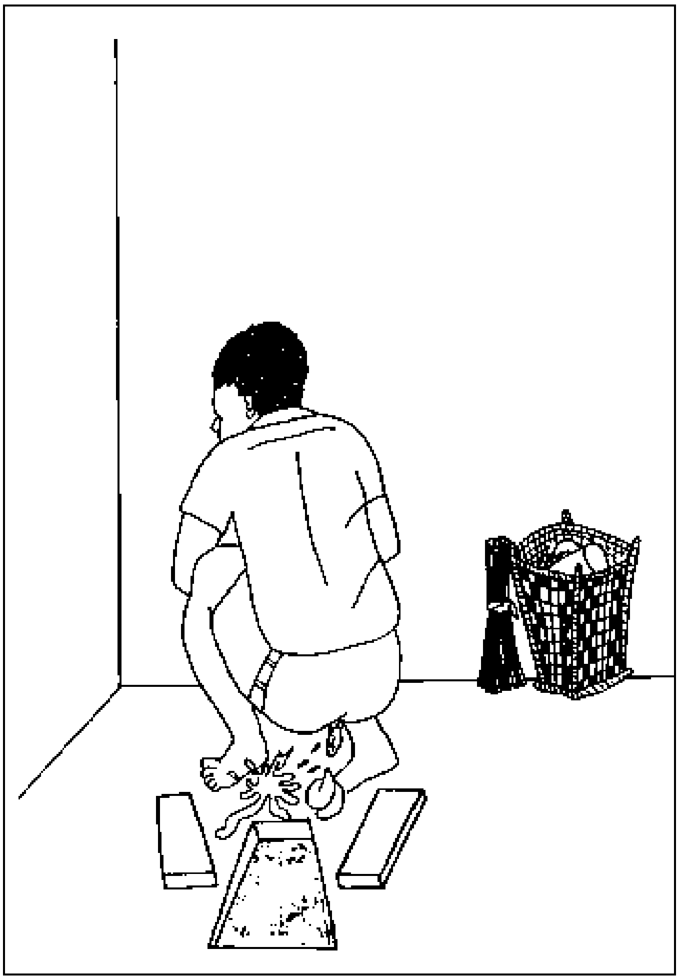
The operating instruction will be followed by regular follow–up visits (see 9.18) and may be repeated if need be.

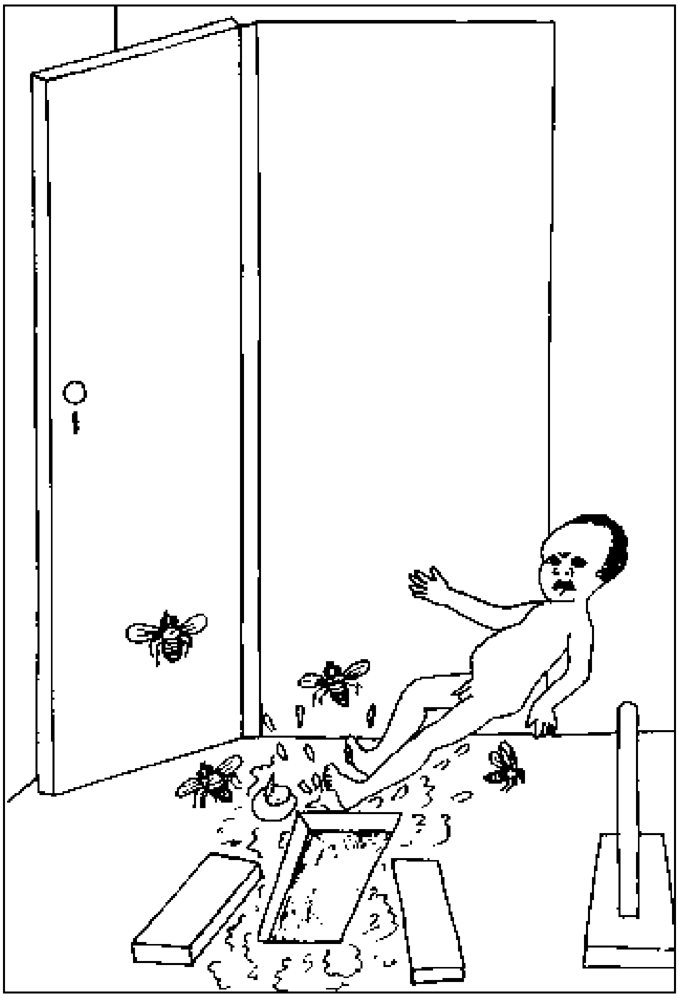


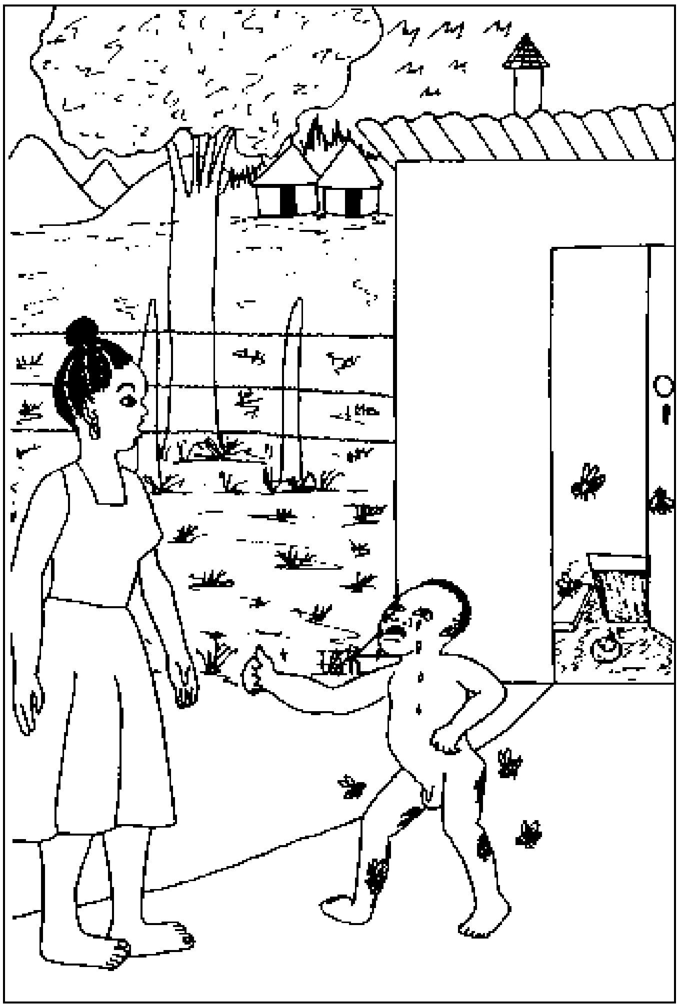


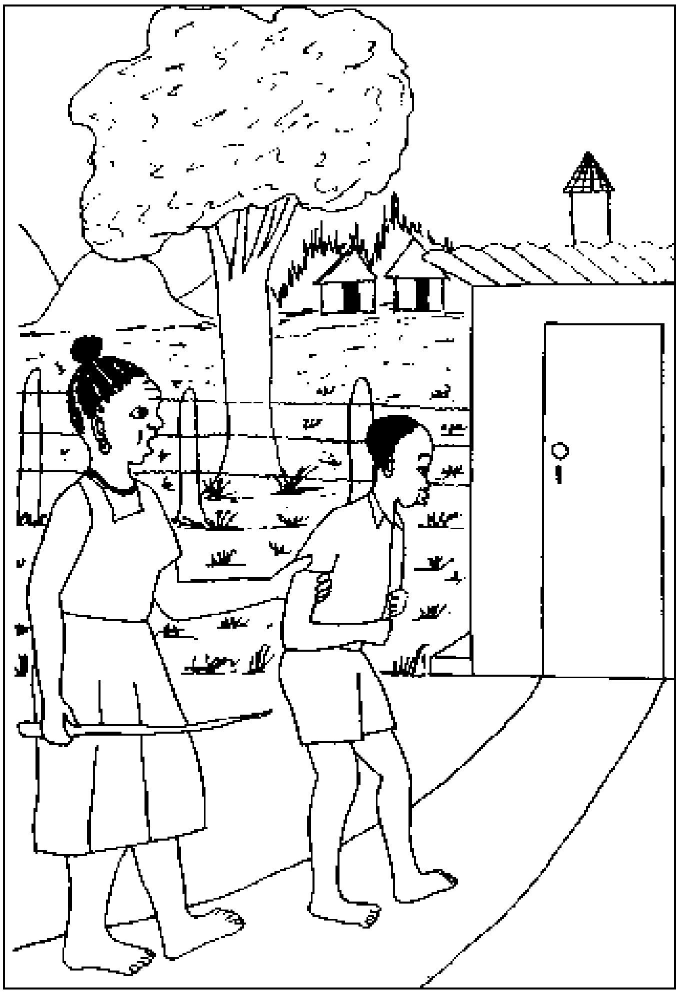


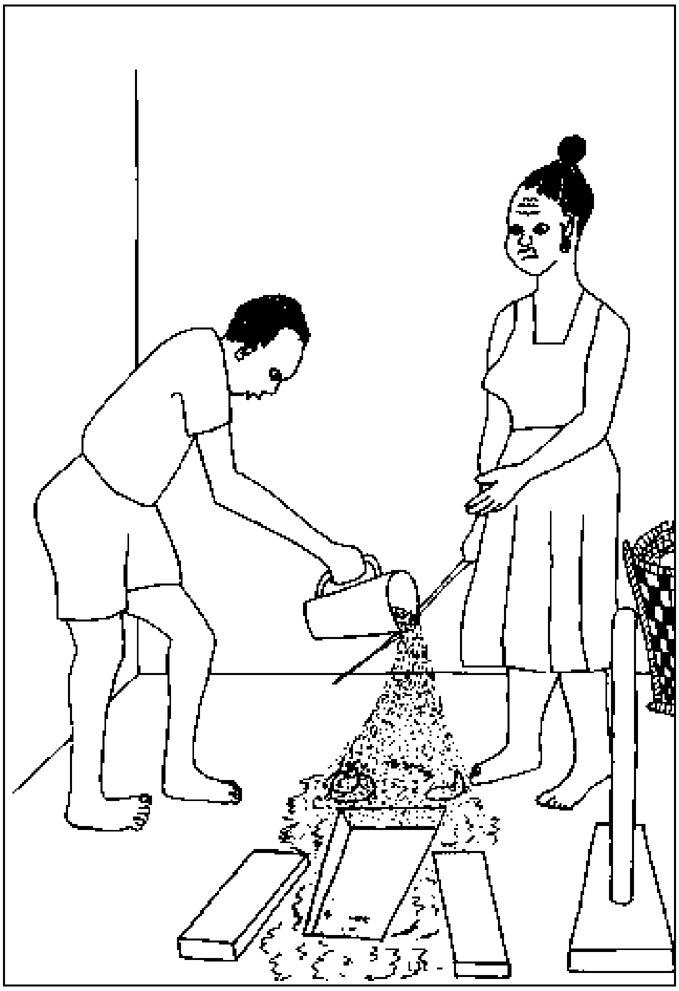


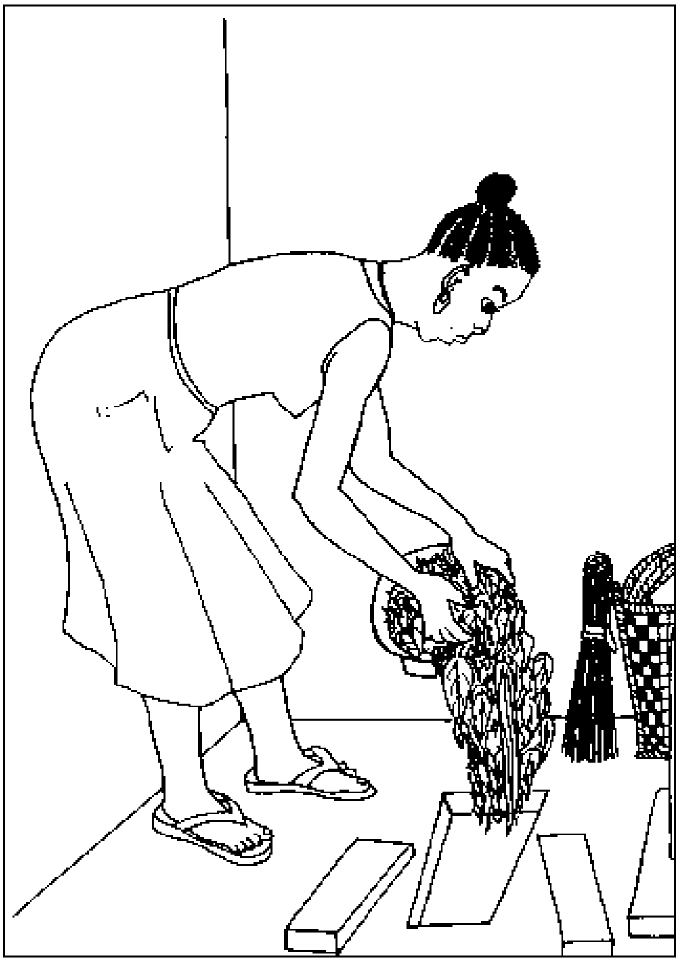


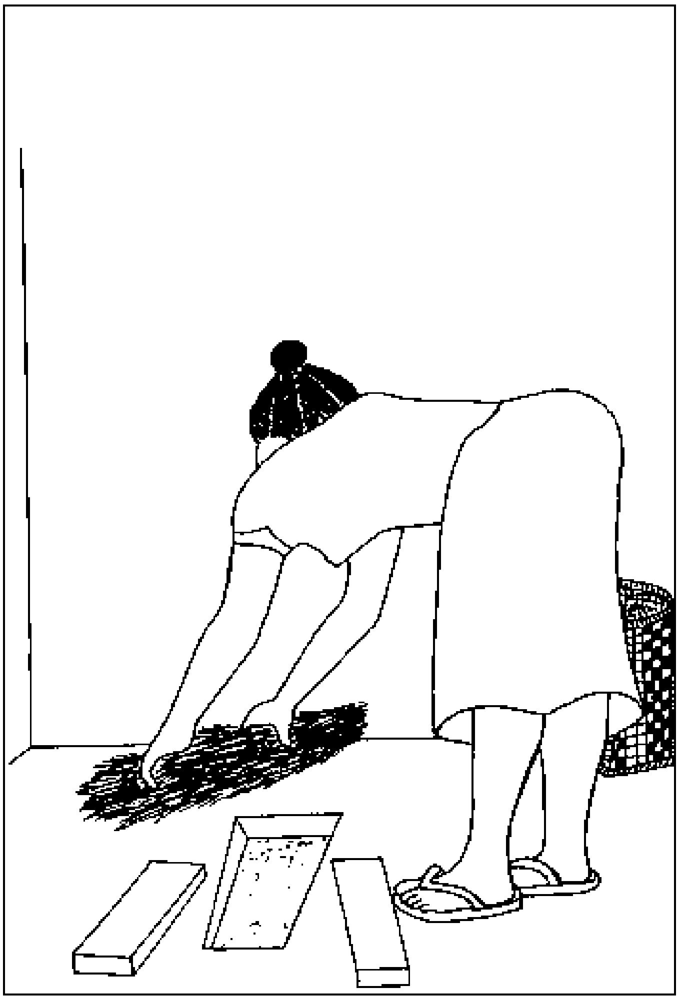










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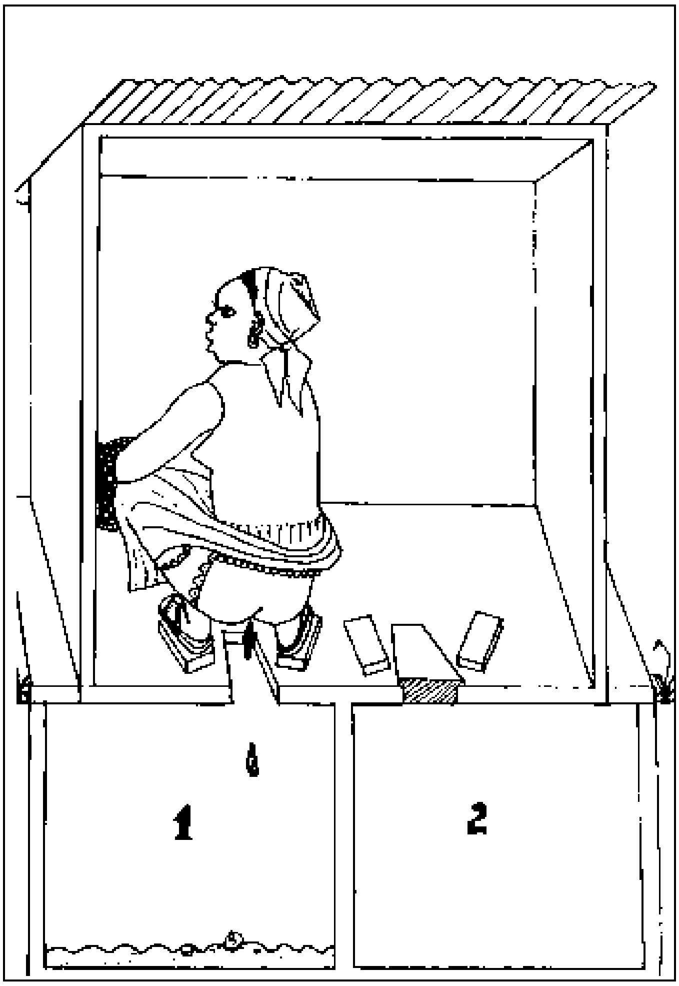
OLD ENGINE OIL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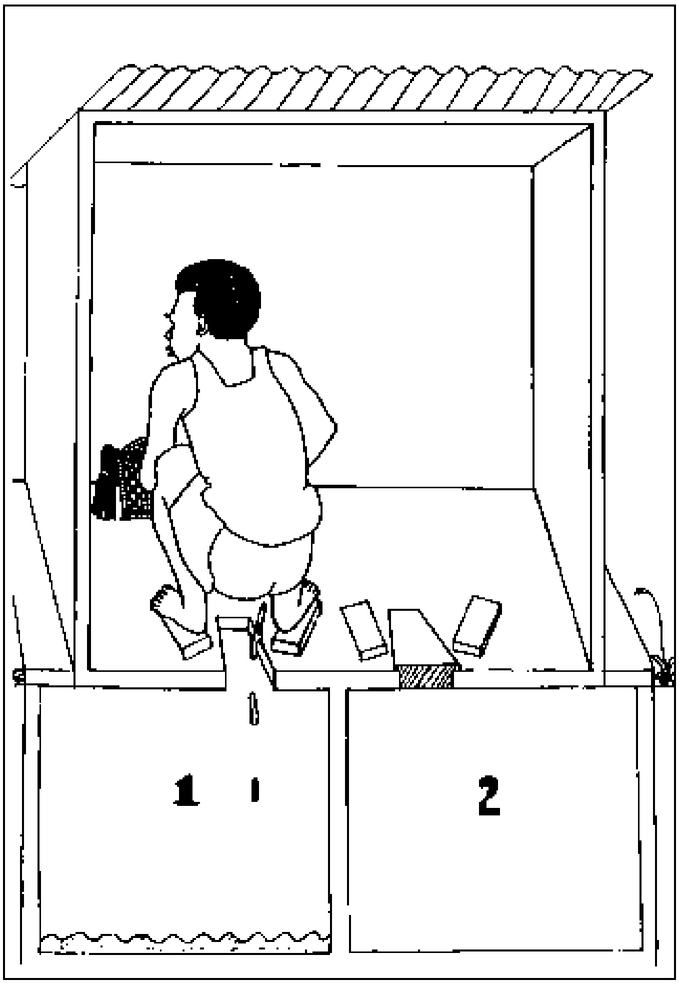
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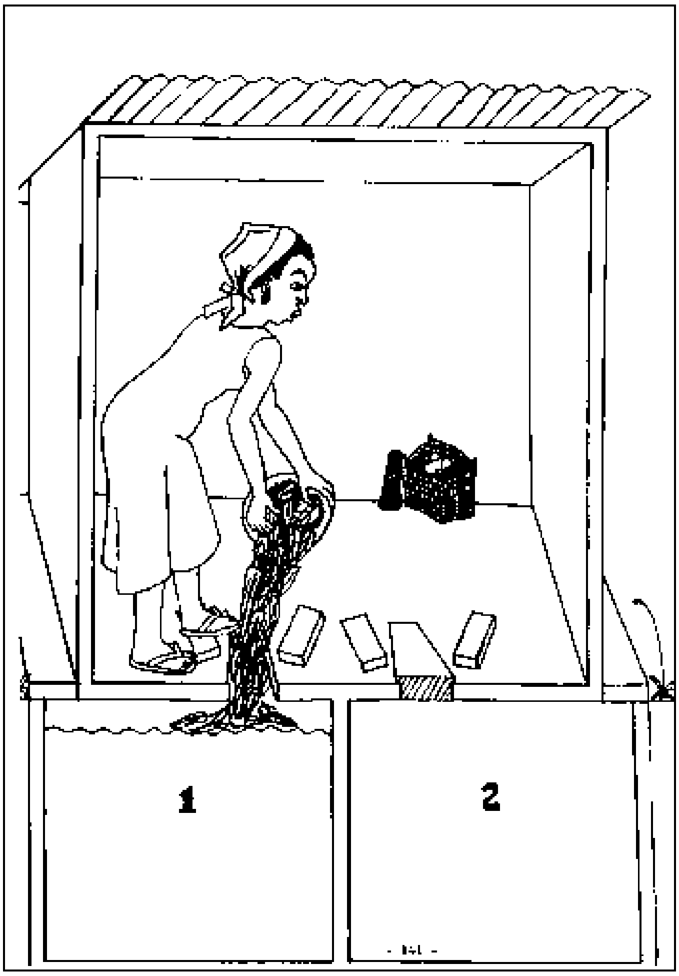
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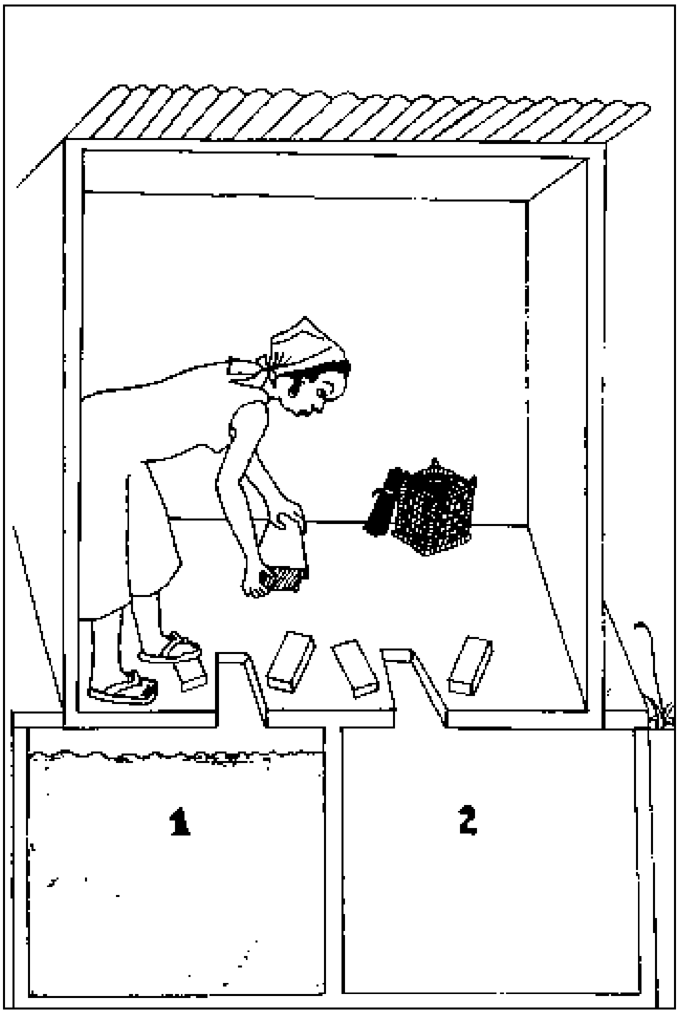
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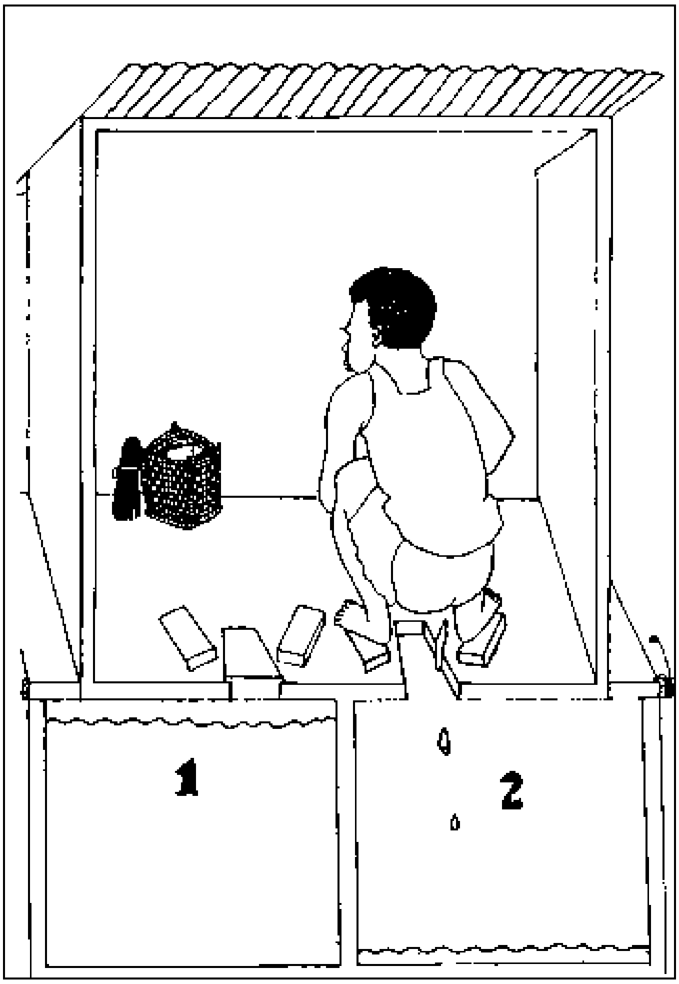
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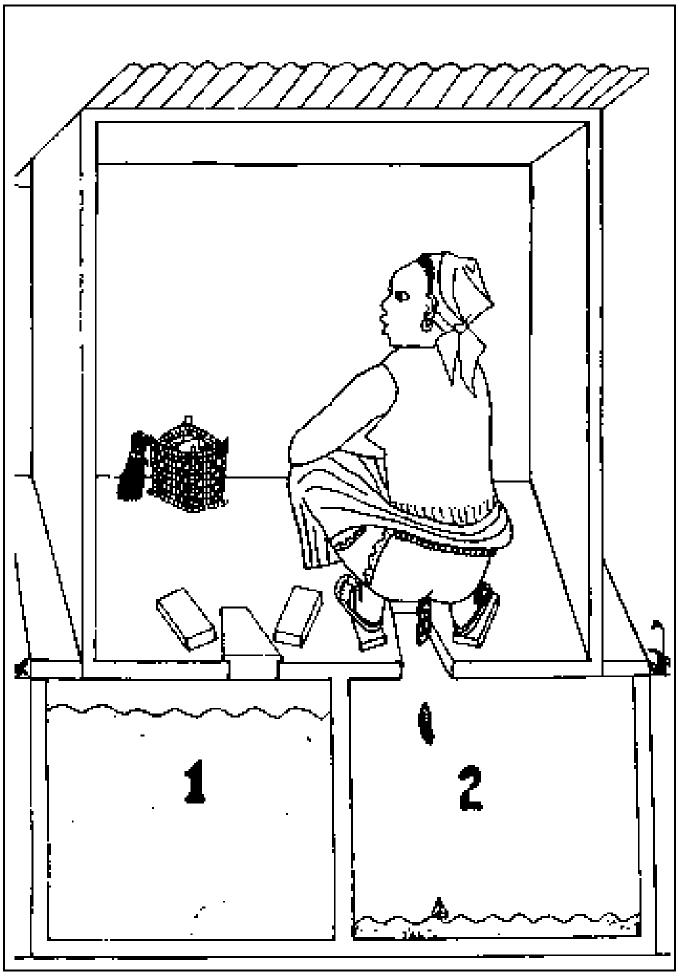
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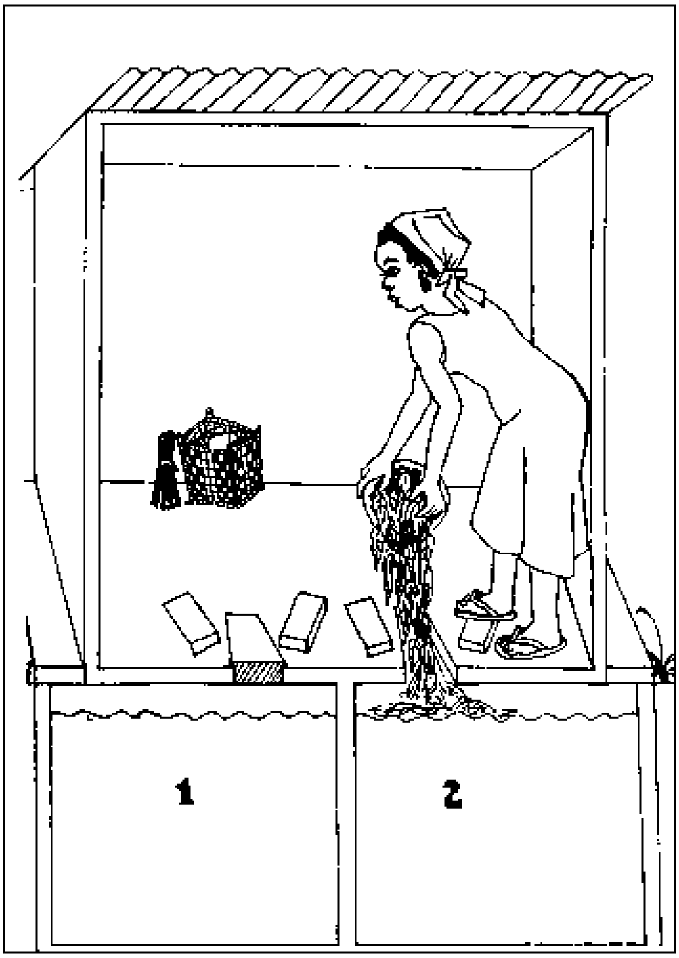
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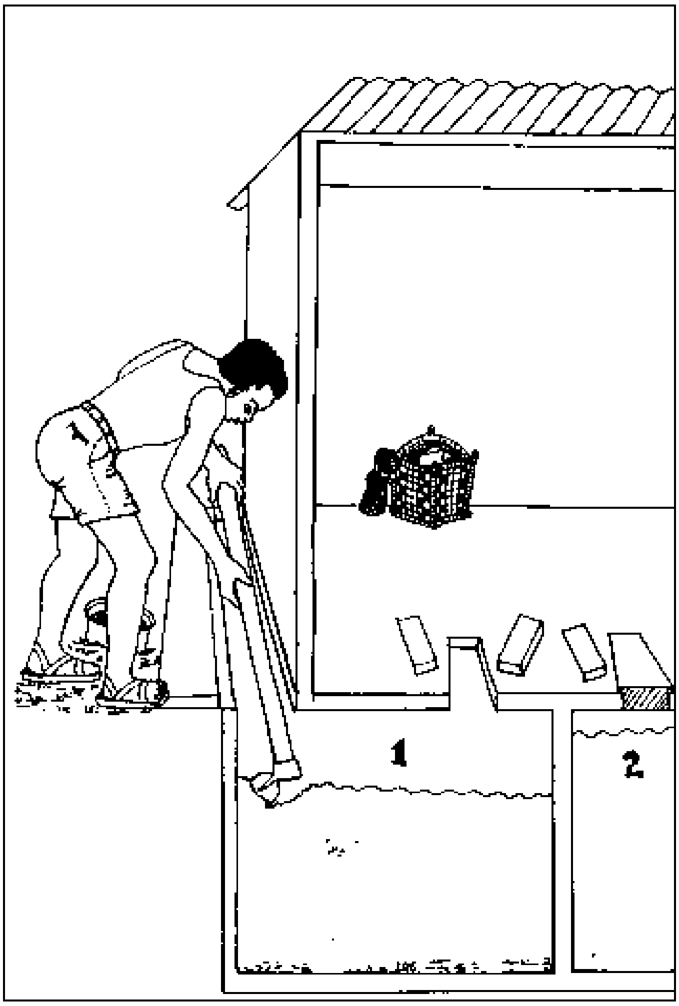
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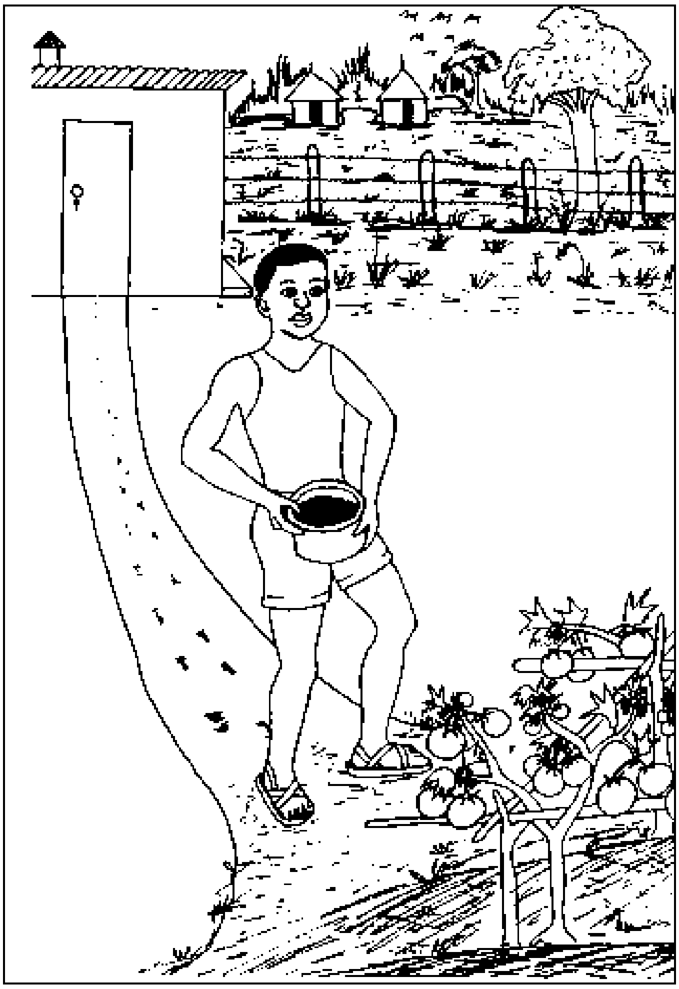

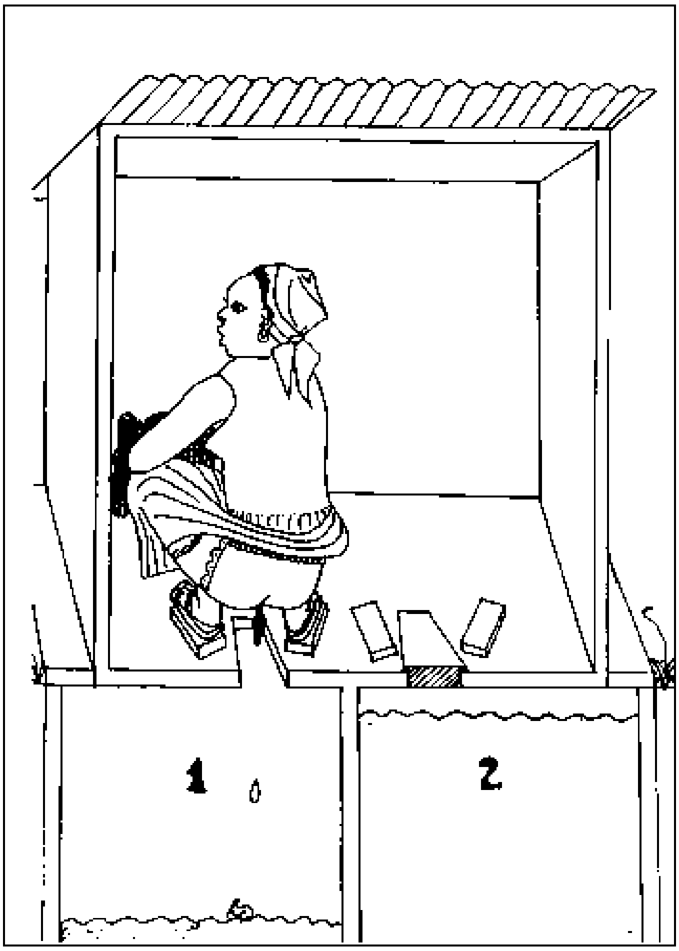
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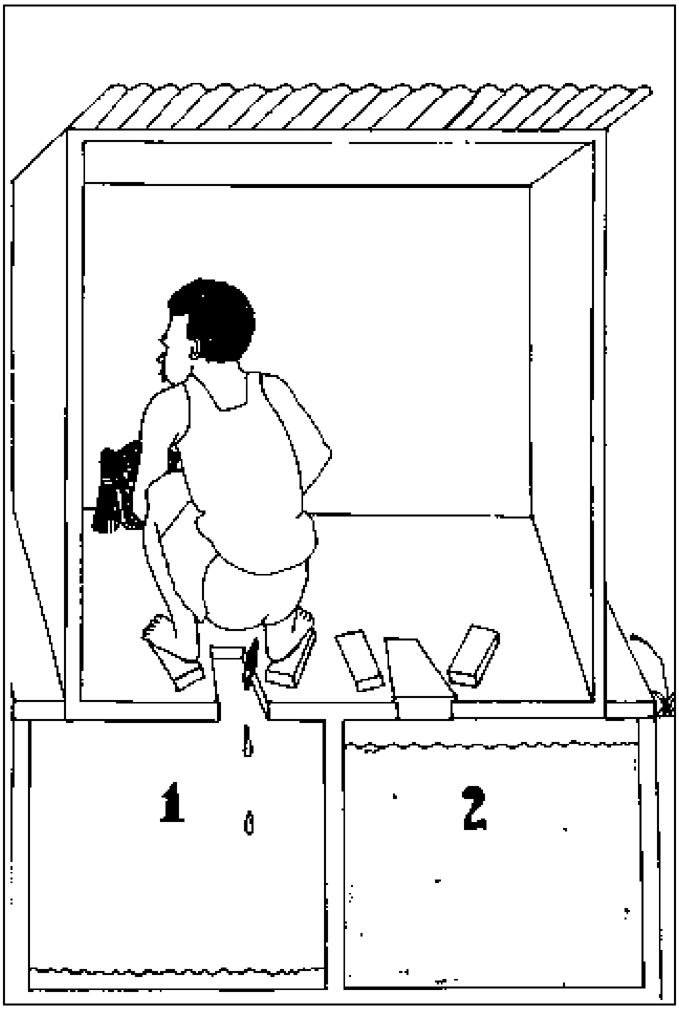


9.18. Latrine Follow–up

It is essential to follow up whether compost latrines are used correctly and, eventually, to advise and encourage the users.

A) Questions to the Users

The following questions need to be discussed with the owner/users.

No.	Question	Possible Suggestions
1	Do you have any problems with your compost latrine?	
2	How many people use the latrine?	
3	When did you start to use this pit?	
4	How full is it?	
5	Did you empty a pit already?	
6	Do you use sand and ashes?	It is preferable to use sand and ashes.
7	Do you regularly add grass, leaves, kitchen waste?	Adding these materials is necessary for better composting.

8	Is the container for ashes and sand filled regularly?	This is very necessary to encourage the users. Little children can be assigned for this task.
9	Do the users sprinkle sand and ashes?	Remind them if they forget.
10	Do you sweep the latrine daily?	This is very important for cleanliness
11	Do you use the broom somewhere else?	The broom shall not be used elsewhere because of transmission of diseases.
12	Are there many flies in the latrine?	Pour lot of sand and ashes. Keep the lid always closed.
13	Are there many flies in. your kitchen?	Keep your compound clean and dry. Bury or burn rubbish.
14	Are there many mosquitoes in your compound?	Your latrine pit must be dry. Your bathing place must be dry. Dig ditches for run−off of rain water. Fill up all water pools in the surrounding.
15	Is the run−off of the bathing place muddy and dirty	Dig a soak−away pit and fill it with stones or broken bricks.

B) <u>Inspection</u>

The following points need to be inspected.

No.	Check	Possible Help
1	Are the latrine surroundings clean?	Clean the surroundings.
2	Is the latrine clean inside?	Clean the latrine inside.
3	Is the latrine slab clean or is there urine spilled ("maps")?	Scratch off any dried dirt. Sprinkle ashes and sweep it into the pit. Rub the slab with wet grass. Do not rinse.
4	Is there a basket with sand and/or ashes, a tin, paper, a broom inside? Is there a wooden lid and a concrete lid on the two holes?	Replace what is missing.
5	Are all the leaflets and posters, "How to use the latrine", on the wall?	Replace what is missing.
6	Look into the pit with a torch. Is there water in the pit? Is everything well covered with sand or ashes?	Fill earth, sand, ashes, grass, leaves into the pit until all water is sucked up.
7	How full is the pit?	If the pit is almost full, the contents can be pushed back with a stick for even filling. Remind the owner to call the project when he wants to change the receptacle.
8	Is there any bad smell?	Put a lot of ashes into the pit to stop it.
9	Are there many flies?	Advise the owner on the correct use (to place the lid, etc.) which will reduce the flies.
10	Are the concrete covers of the emptying holes well covered with earth and air tight?	Cover the concrete covers with earth.
11	Is any place around the latrine and especially the steps washed out?	Fill any washed out place with earth.
12	Does the mosquito wire on top of the ventpipe have holes?	Replace it by new mosquito wire.

Do not forget to fill in the form, "LATRINE FOLLOW−UP" after each check and put it in the file of the latrine. This is necessary to see any improvement/deterioration and to evaluate by comparing with other latrines and over a certain period of time.

Sudan Council of Churches * Munuki Water and Sanitation Project

LATRINE FOLLOW−UP

Latrine No:...
Owner:..
Site:..

Number of follow−up visit...........

Check done by..........................   Date:...

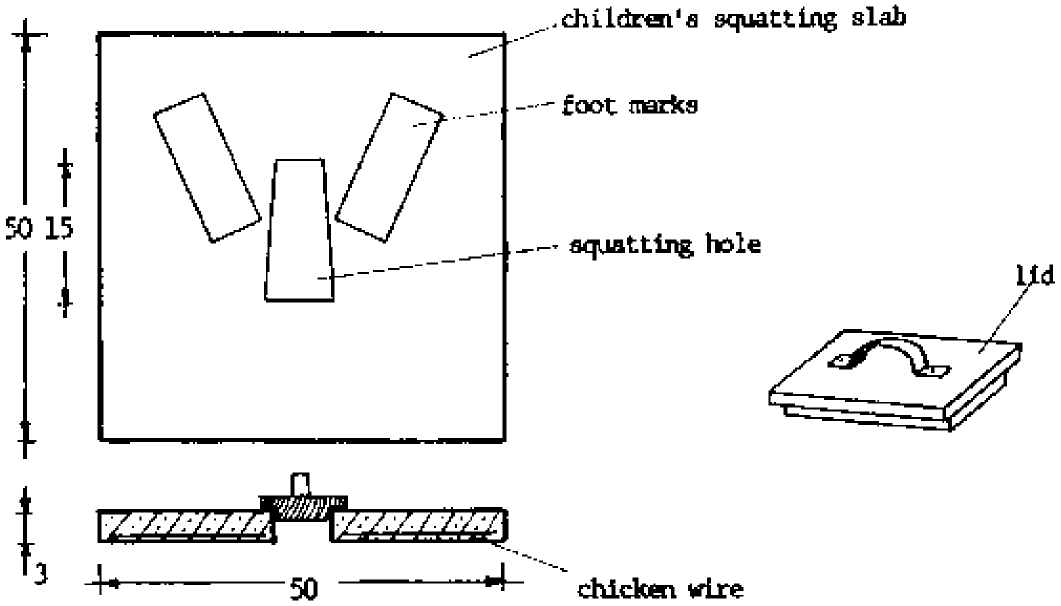
How many people use the latrine?		....
How full is the pit?		....
Is there water in the pit?		yes/no
Is the lid on top of the squatting hole?		yes/no
Are sand and ashes available?		yes/no
Are sand and ashes sprinkled?		yes/no
Are grass/leaves/kitchen waste/................./............. added		yes/no
Are there flies?		yes/no
Are there mosquitoes?		yes/no
Is there a bad smell?		yes/no
Are the covers for emptying well covered?		yes/no
Is the mosquito wire on the ventpipe all right?		yes/no
Has the second compartment been started?	Date:	yes/no
Has the first compartment been emptied?	Date:	yes/no
Were the contents decomposed properly?		yes/no
Is the latrine clean? very dirty 0 1 2 3 4 5 very clean		

Remarks:
....
....
....
....
....
....
....
....

9.19. Children's Squatting Slab

Children will learn after a certain age to imitate the adults when defaecating. However, because the squatting holes of the latrines are too big, they will not go there, but just squat anywhere, in or near the compound. Thereby, they will provide breeding places for flies and contribute to the transmission of diseases. This can be helped by taking the excrements of a child immediately and throwing them into the latrine. However, the children's squatting slab will provide an easier solution and can additionally help to introduce the child into using a latrine properly later on. It will also help to reduce the nuisance of smell and flies from the excreta of the children squatting just anywhere.

The children's squatting slab is a slab of 50 × 50 cm from concrete, reinforced with chicken wire with a small squatting hole in the middle. It has a wooden lid.

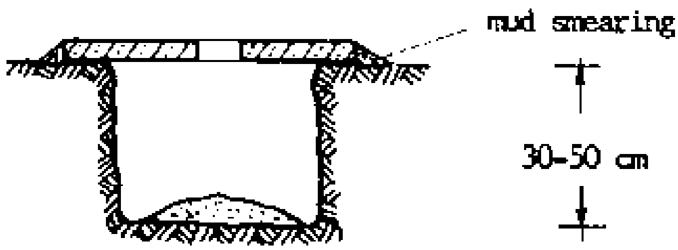


SCALE 1:10

It is to be used as follows:

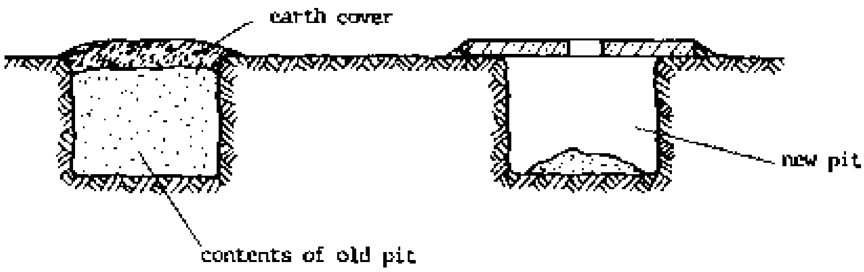
1. Dig a pit a bit smaller than the slab so that the slab can rest on the edges of the hole. It should not be deeper than 50 cm and in a place which is not flooded by rains. Put the soil of the digging aside and partly around the edge of the pit, to raise it a bit above the normal ground

2. Place the slab and smear the edges with mud so that it is sitting firmly on the ground. Put the lid on the squatting hole.



3. Teach the children to use the squatting hole properly, to put some sand or earth into the hole after defaecation and to replace the lid after finishing.

4. When the pit is full, take away the slab and put it on a new pit. Cover the old, full one with earth.



9.20. Bath and Soak–Away Pit

A place for taking a bath is essential for personal cleanliness and hygiene. It can be within the house with running water from a tap or a separate building, where we get water from an elevated tank, or just a place with a fence using water from a bucket. However, in any case it is important to keep it clean in order not to make it a breeding place for germs and let it become a smelly nuisance, especially if it is also used for urinating.

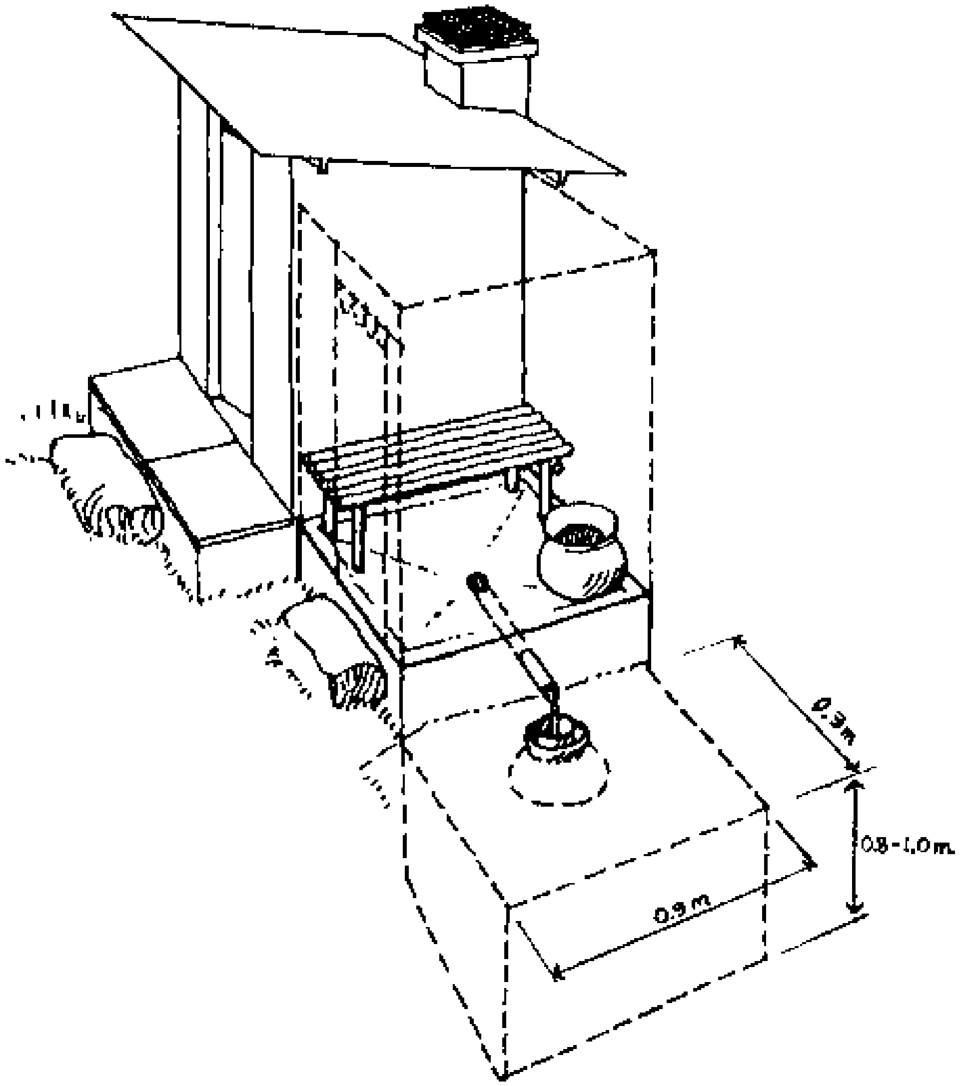
Therefore, take care that

– there is never standing water in the bathing place, but that it can run off easily;

– the water is not just running outside and then forming a cess–pool stinking in front of your fence;

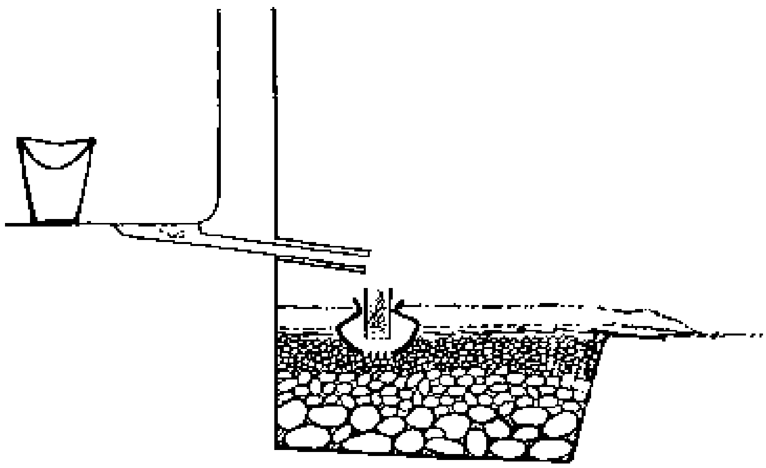
– you clean the bath regularly with enough water and soap. Normally, there is no need for disinfectants like Dettol, Finik, etc., if you keep the place clean and dry. Disinfectants should be used only if there are fungi infecting the feet. Then disinfect the bathing place – using boiling water is as effective as any disinfectant. Do not forget to treat the disease, otherwise it will just spread again.

A latrine with bath and soak–away pit:



To prevent water from standing, care for proper drainage and a soak−away pit. A soak−away pit to last for many years and not be clogged by grease and silt and bacteria, must be built properly.

Cross−section through soak−away pit:



In order to build a proper soak−away pit, do as follows:

1. Choose the Proper Location

It should be at least 6 m distance from the house and 30 m from the nearest source of water supply. It should not be in an area where surface water will stand or flow over it sometimes. The soil should be neither pure sand nor pure clay.

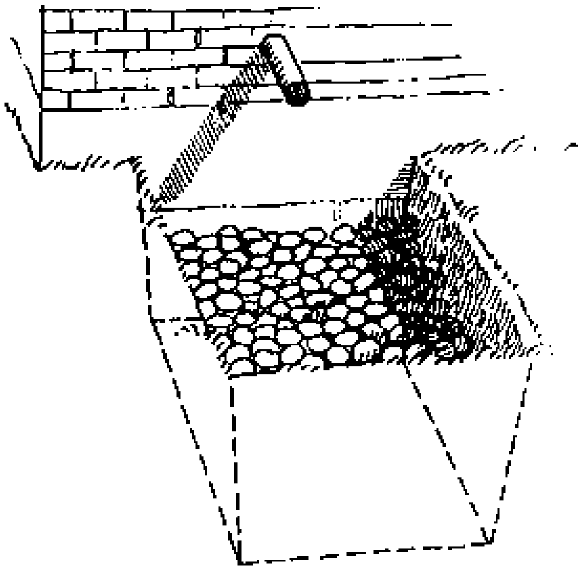
2. Dig a Pit

The bottom of the pit should be at least 1 metre above the groundwater level in rainy season and 1 m above any impervious layers. The size should be about 1 m deep and 1 to 3 m diameter.

3. Fill the Pit

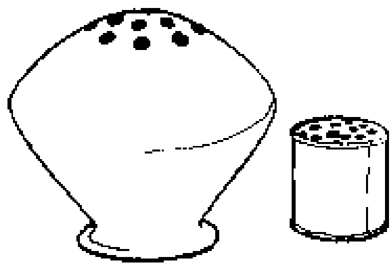
In the bottom third, big stones (about the size of a papaya), on top of that the next third, middle size stones (about as big as mangoes). The rest shall be filled with small stones or gravel; if available, you can put a layer of charcoal in between.

Soak−away pit with second layer of middle size stones:

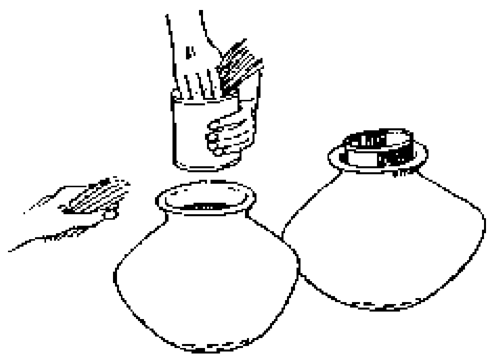


4. Prepare and Put a Silt and Grease Trap

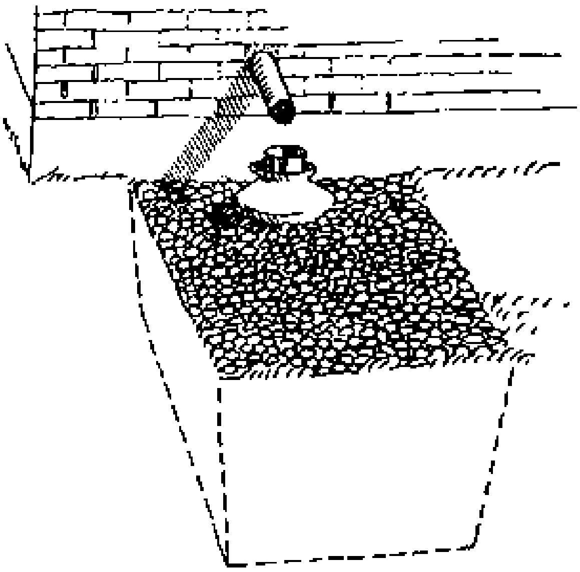
Make holes into the bottom of a clay pot and a tin fitting into the mouth of the pot.



Fill the pot with grass or straw, but do not press it together. Put the tin into the mouth of the pot and fill it also with grass.



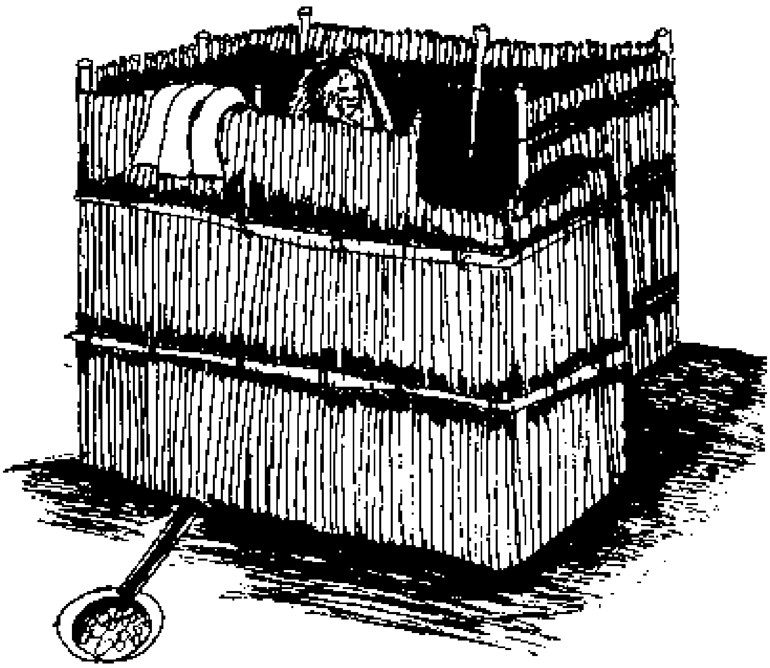
Put the pot with the tin into the layer of small stones under the outlet of the waste water.



5. Cover the Pit with palm leaves and old sackcloths or mats, so that only the silt trap looks out. Cover the mats with 5 to 10 cm of earth.

For maintenance you have to change the grass in the pot every two weeks.

If the pit is not soaking anymore (after some years), take out everything, wash the stones, take away a layer of soil from the walls of the pit and let it dry out. Then start again at step No. 3 to re–do it.



9.21. Handling Waste Matter in The Home

Beside excreta, there is other waste matter in the household which needs to be handled in a proper way to avoid diseases.

A) Principles

1. Minimize rubbish (e.g. by using a basket for shopping instead of buying new nylon bags each time).

2. Check to see if waste can be a resource by reusing/recycling it.

3. Whenever you are collecting, handling or disposing of waste, take care not to get injured (if you do, disinfect and clean immediately), and wash afterwards with soap and enough water.

B) <u>What Can You Do with Waste Matter?</u>

In crowded areas only a collection system could ensure safe disposal. However, if that is not available and we cannot re–use the waste safely, we should try to get rid of it in a safe way, that is:

1. <u>Rubbish</u>

Rubbish means all material which is not organic, like broken utensils, scraps of metal, glass, nylon bags, old batteries, rubber, etc.

If you collect rubbish in a waste–bin, do not mix it with garbage.

Always cover the bin not to allow rats, flies, etc. to live and breed in it.

Re–use it if it is possible in a safe way, e.g. use nylon bags several times after washing them, or re–use tins, but cut them open with a tin–opener to have a smooth edge and you will not cut yourself.

Bury it regularly in a suitable pit. The pit needs to be far enough from wells and streams to prevent water pollution. The bottom of the pit should be at least 1 m above the water table in rainy season.

The pit should also be far enough from houses to prevent nuisance by smell, flies, rats, etc.

Eventually burn the rubbish, but always cover it with soil.

2. <u>Garbage and Other Organic Matter</u>

Garbage means organic matter like food and crop waste, sweepings, kitchen leftovers, etc. Additionally, there is organic matter like small branches and leaves, animal manure, dead animals and ashes. Do not mix it with rubbish, but collect it separately. Re–use if possible and safe, e.g. kitchen leftovers as animal food. Recycle by using it for composting, either by throwing it into your compost latrine, or on a compost heap. A compost heap you can make by digging a pit, 1 m deep, throwing the waste in and covering it with earth immediately to prevent flies, rats, etc. It is very good if you can mix garbage, animal manure and ashes. This will give a very good manure for the garden.

Ashes you can also re–use for cleaning, for your pit latrine or compost latrine, or for making combo.

In case of bigger dead animals you have to bury them deep enough and cover them properly with soil to prevent them from being dug out again by dogs or hyenas.

3. <u>Paper</u>

Paper can be completely re–used if it is collected in a separate basket, either as scrap paper for drafts, for wrapping things, for the latrine or for lighting a fire.

4. <u>Waste Water</u>

Waste water can be re–used for

– cleaning,
– watering trees or the garden (if it is not too soapy).

If it is not re–used, it should be disposed of in a soak–away pit (see 9.20).

9.22. Pesticides

A) General Information

Pesticides are poisonous chemicals for killing "pests", that is insects, weeds, fungi, etc. They are designed for use in agriculture, disease control (mosquito control), timber protection, etc.

Pesticides are advertised as offering a promise of a better life, easier and more comfortable, higher production and higher profits.

But

– they do not fulfill these promises, especially in the long run: Even if production increases, there is no guarantee that the poor will share the benefits. They will rather be the ones suffering most from the side effects.

Costs are increasing and a crisis develops between worsening control of the pests and spiralling prices, and efficiency decreases.

– they have serious side effects, especially, if used uncontrolled.

The background for the uncontrolled use of pesticides in Sudan and other Third World countries shows a new dimension of underdevelopment: beside the economical exploitation there is an ecological exploitation. Chemicals whose production, marketing and use are forbidden in industrialised countries, because of its well–known dangers for the health of people and the environment, are produced, marketed and used in Third World countries. E.g. West Germany exports yearly 140,000 metric tons of chemicals whose use in Germany is either severely restricted or forbidden at all.

Annually there are about 500,000 poisonings' in connection with pesticides according to WHO and a high rate of unreported cases.

Poisonings happen because of misuse or overuse by

– poor training in the proper use and improper handling and use;
– irresponsible marketing practices;
– spraying on calendar schedule.

There is also a very low awareness about the dangers among the public. Pesticides are seen as "medicine" (almost in a magic sense) and not as the poisons they actually are.

The legislation in Third World countries is often not sufficient and, where it exists, problems arise because of inadequate enforcement.

See also 8.7/4.

B) Example DDT

DDT is a very good example for all the things described above:

DDT is one of the "Dirty Dozen", that is extremely hazardous pesticides which are banned or severely restricted in industrialized countries as threats to public health and environment, e.g. in Germany it has been forbidden since 1972. In Sudan its use was officially banned in 1980 according to some literature, but just to be replaced by other chemicals of similar kind or to be used inspite of the ban.

The chemical name of DDT is DichlorDiphenylTrichlorethane ($C_{14}H_9Cl_5$) Its use as an insecticide was detected in 1939.

It is so far prohibited in 15 countries because of its

– toxicity:

This is increased by DDT being persistent and accumulating in body fat at each level of the food chain, and it is also increased in case of a protein deficient diet.

– residual action on humans, the wildlife and environment:

It concentrates in mothers' milk and in the fat tissue of the body. In Sudan it was used in the Gezira since 1947. The result is that in the fat of a Sudanese a residue content of an average of 30.9 ppm is found compared to a world level of 6 ppm.

Because DDT is essentially non–biodegradable in the environment, it is meanwhile present in virtually all foods and living things. The half–life of DDT in soil is a minimum of 2.5 years, that means that after 2.5 years half the amount originally applied will still be there, after five years a quarter, and so on. Its break–down products, DDD and DDE, are also extremely long lived and extremely toxic for fish and birds.

– alteration of the ecological balance:

DDT is lethal to many predators and parasites of the target pests. It also contributes to the deterioration of the soil quality because of destruction of micro–organisms, earthworms and ground insects. The World Bank, therefore, suggests it not to be used in agriculture.

– development of resistance:

It was originally thought of as a weapon against malaria. Meanwhile, 51 out of the 60 malaria–bearing mosquito types are resistant, and altogether there are more than 300 DDT–resistant pests now.

– health risk:

It is thought to be carcinogenic (= causing cancer). It also causes nerve and brain damage, as well as liver and kidney damage and tremors. There is also a decrease in sperm count reported which may be due to impurities of DDT.

C) Safety Precautions

For the use of DDT and other pesticides, the following safety precautions are necessary:

– Wear protective clothes which cover the whole body including a hat and veil covering the whole head, and long gloves.

– Wear special working clothes which are to be removed at the end of each working day.

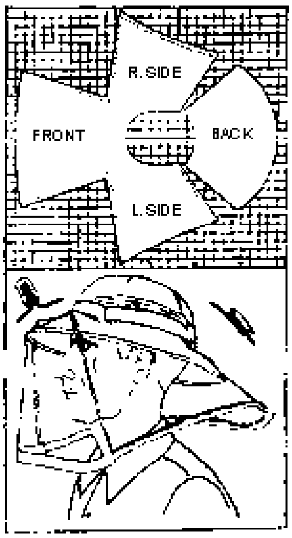
– Wash the clothes and the body using soap at the end of work with sufficient water, using separate containers for cleaning which shall not be used for anything else. Dispose of the water in a safe way.

– Wear rubber boots.

– Handle the pesticide with special implements and not with the hands or containers used for other purposes.

– Secure safe transport and storage and proper equipment for application including spare parts and repair facilities.

It is quite clear that all these do not happen in practice for different reasons. However, the question to be asked is whether the use of pesticides is necessary and reasonable at all, and, if necessary, when and where to use them, or whether there are safer alternatives.



10. Appendix

10.1. List of Abbreviations

A/...	Assistant...
Adm.	Administration
BH	Borehole
ca.	circa = about
CD	Community Development
CDO	Community Development Officer
CL	Compost Latrine
c/o	care of
e.g.	exempli gratia = for example
etc.	et cetera = and so on
...f	... and the following page
...ff	... and the following pages
GW	Groundwater

HP	Hand Pump
ID	Inside Diameter
i.e.	id est = that is
L	Latrine
Log	Logistics
£S...m/ms	Sudanese Pounds... milliemes
OD	Outside Diameter
pc	Piece
pcs	Pieces
PMT	Project Management Team
San	Sanitation
SCC	Sudan Council of Churches
W	Well
WC	Water Closet
WS	Water Supply
WT	Water Table

Abbreviations for Measurements see 5.3

Abbreviations in Mathematics see 5.4 and 5.7

10.2 List of Forms

10.3 List of Leaflets and Posters

10.4. List of Illustrations (from literature)

References to illustrations page numbers and authors given in the table below reflect the printed version. In order to have the exact correspondence please consult the PDF version of this file.

All illustrations not mentioned in the following list as well as the adaptions were made by Márta Guóth−Gumberger.

Section	Illustration Page No.	Taken from/Made by
1	1.3/2; 1.6/6; 1.7/1	Ben Hakim
2	2.4/4; 2.7/2; 2.8/2; 2.12/1	Ben Hakim
	2.18/1−4; 2.18/6	bibliography No. 12; 27
3	3.1/2; 3.3/2; 3.6/1; 3.7/1; 3.8/1; 3.9/3	Ben Hakim
4	4.8/1−3; 4.19/3	Ben Hakim
	4.4/2; 4.8/5; 4.12/1f; 4.14/3−6; 4.18/4f	Mike Gogonya
	4.1/4	The Guardian Weekly
	4.6/1	The International Women's Tribune
	4.6/3 (below)	Sueddeutsche Zeitung
	4.6/3 (top); 4.8 (adapted); 4.12 (adapted); 4.14 (adapted); 4.16/2; 4.18 (adapted); 4.23/3 (below); 4.27 (partly adapted)	bibliography No. 20; 37; 48
6	6.4/8; 6.6/14	Ben Hakim
	6.3 (partly adapted)	catalogue 1986, Luna AB Sweden, and catalogue 1983, Mittermeyer, W−Germany

	6.1/20	manual diaphragm pump, Van Reekum Materials, Netherlands
	6.1/21	manual Hatz Generator, West Germany
	6.1/22 (bottom); 6.6/2 (adapted); 6.6/6; 6.7 (adapted)	bibliography No. 6a; 8; 44
7	7.2/2; 7.3/1; 7.6/3; 7.8/3; 7.12/3	Ben Hakim
8	8.7/5; 8.9/2; 8.37/7 (left); 8.39/3−7	Ben Hakim
	8.24/24 (adapted)	leaflet, Mono Pump
	8.24/29	leaflet, Homa Pump
	8.24/30	leaflet, Jet pump
	8.24/7−30 (partly adapted); 8.30 (adapted); 8.35 (adapted); 8.37/4,6	bibliography No. 18; 21; 22; 44; 46
	9.9/2; 9.19/2; 9.20/5; 9.21/2	Ben Hakim
	9.6/1,2(bottom), 3−10; 9.17/2−32	Mike Gogonya
	9.1/2; 9.2/2; 9.2/3; 9.6/2 (top),4 (bottom)	Stephen Hakim
9	9.3/1; 9.3/2; 9.3/5f; 9.5/2f (adapted); 9.6(adapted); 9.12/2; 9.12/3 (adapted); 9.12/4 (top, adapted); 9.20/1−4; 9.11/2; 9.22/3	bibliography No. 6; 23; 34; 48; 49
0 to 9	drawings title pages	Ben Hakim

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Construction Manual for Earthquake−Resistant Houses Built of Earth

Table of Contents

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Gernot Minke

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The layout and computer drawings were prepared by Friedemann Mahlke, the freehand sketches by Vera Frey.

Kassel, December 2001
Gernot Minke

Introduction

The solutions proposed in this manual concentrate on low−cost single−story houses, built from earth in rural areas of earthquake−prone zones. They are based on research projects carried out at the Forschungslabor für Experimentelles Bauen (Building Research Laboratory) of the University of Kassel, Germany, on the analysis of earthquake damage in Latin America, on studying relevant literature and on the implementation of several test structures in Germany and prototype houses in Guatemala, Ecuador and Chile.

Using locally available building materials as well as the skills of local craftsmen should be considered for the design of seismic−resistant (earthquake−proof) houses and it should be proved that the solutions are accepted by the users.

Earth as a building material has lost its credibility mainly because of the fact that most modern houses with earth walls could not withstand earthquakes, and also since earth is considered as the building material for the poor. In this context it is worth mentioning that a census conducted by the Salvadorian Government after the earthquake in January and February 2001 states that adobe houses were not worse affected than other houses.

In many areas of the Andes regions building with adobe (unburned, unstabilized handmade soil blocks) is forbidden nowadays. Nevertheless, the majority of the rural population still builds with this building material, as it cannot afford to build with bricks or concrete blocks.

When designing low−cost houses for rural areas it should be taken into account that structural failures as a consequence of an earthquake have to be avoided, whereas minor damage like small cracks must be tolerated if it can be easily restored.

For more information about the different building techniques with earth, the physical and structural characteristics of earth and the possibilities of improving them, reference is made to the "Earth Construction Handbook" by the author, published at WIT Press, Southampton, UK 2000, or to the "Manual de Construcción en Tierra", publicadora Nordan, Montevideo, Uruguay 2001.

1. General aspects of earthquakes

1.1 Location, magnitude, intensity

An earthquake is produced either by movement of tectonic plates or by volcanic activity. The areas of the world that are most earthquake−prone are shown in Fig. 1−1. Earthquakes of intensity 8 on the Richter scale have been recorded in Asia and of up to 8.7 in the Andes . Nearly a hundred earthquakes of intensity higher than 6 and twenty of intensity higher than 7 on the Richter scale are recorded annually. Several thousand people are affected by earthquakes every year.

The magnitude (M) of an earthquake usually is measured on the Richter scale, which is logarithmic with an open end. It is a measure of the energy produced in the epicenter, the place where the earthquake is generated. The Mescali scale, on the other hand, is divided into 12 grades and indicates the intensity of the local impact.

The local impacts on a structure depend not only by the magnitude of the earthquake, but also on the depth of and distance from the epicenter, the geology and topography, the kind of local soil and last but not least on the duration, frequency and acceleration of the impacts.

1.2 Structural aspects

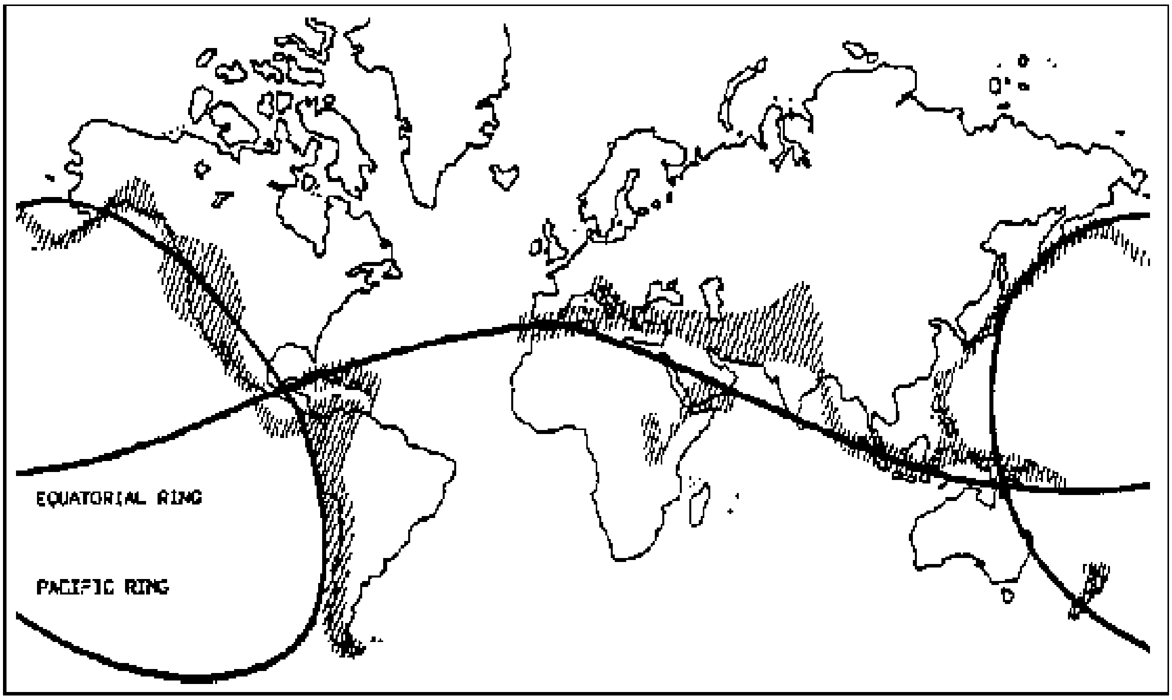
Structures are mainly affected by the horizontal forces created by the earthquake. The vertical forces are usually less than 50% of the horizontal ones.

The main danger due to horizontal movements of the earth is that the walls of buildings might fall outwards and consequently the roofs collapse. The main aim of building earthquake−resistant houses, therefore, is to avoid walls being able to fall outwards and to ensure that the roofs are fixed well to the walls, or even better that they stand on a system of posts separated from the wall, so that the roof system and the walls can swing independently due to their differing frequency.

With a "medium" earthquake the following measures have to be taken into account:

horizontal deformation:	h = 0.1 to 0.3 m
horizontal velocity:	v = 0.1 to 0.3 m/s
horizontal acceleration:	a = 0.1 to 0.3 m/s^2 = 0.15 to 0.30 g

A horizontal acceleration of 0.3 g means that 30% of the dead load of the structural elements acts as horizontal force against the structure ("equivalent force"). Usually simple structures are calculated by the method of "equivalent force", in which the horizontal impact is taken as a static force and not as a dynamic one.



1–1 Earthquake zones (Houben, Guillaud 1984)

However, the higher the ductility, the capacity for deformation without structural failure, the lower the equivalent force is and the lower the structural resistance must be.

The quality of an earthquake–resistant structure can be expressed in the formula

structural quality = resistance x ductility

This means the lower the resistance of the structure is, the higher the flexibility must be, and the higher the flexibility is, the lower the resistance must be (Grohmann, 1998).

The historical rammed earth houses with walls of 60 to 100 cm thick had enough resistance to withstand earthquakes and did not need to be flexible. For instance in Mendoza, Argentina, these houses withstood all earthquakes of the last centuries, whereas all modern buildings built of adobe or bricks collapsed. However, these structures are not economic nowadays. Economic solutions have less rigidity, therefore they must allow deformation during seismic shocks without collapse.

2. Placement of house in the case of slopes

In earthquake–prone areas, where the site is inclined, the following rules must be taken into account:

a) The house should not be cut into the slope, as the adjacent wall might collapse due to the horizontal forces of the earth, see Fig. 2–1

b) The house should not stand on the slope as it might slip down

c) The house should not stand near steep slopes as it might collapse due to falling rocks or earth avalanches, see Figs. 2–3 and 2–4

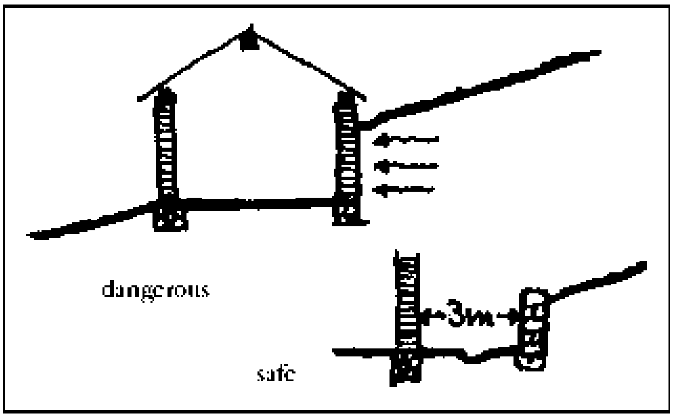
d) If a slope is given, a platform has to be formed and the house has to be placed at sufficient distance from the slopes, see Fig. 2–5

e) It is recommended that massive and heavy houses stand on soft sandy soils, whereas light flexible structures can stand on rocky soils.

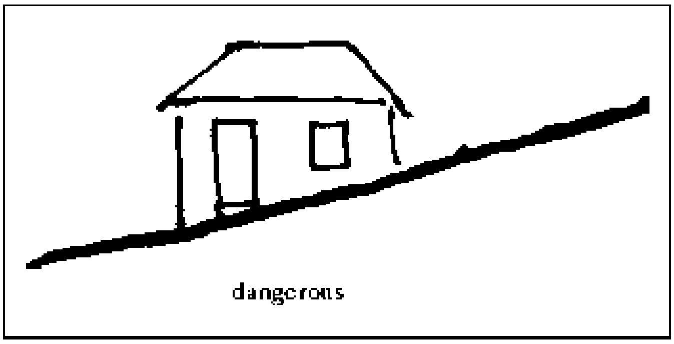
f) Different floor levels should be avoided.

If it is necessary, the rooms should be separated.

2–1 to 2–5 Location of a house on the slope



2–1



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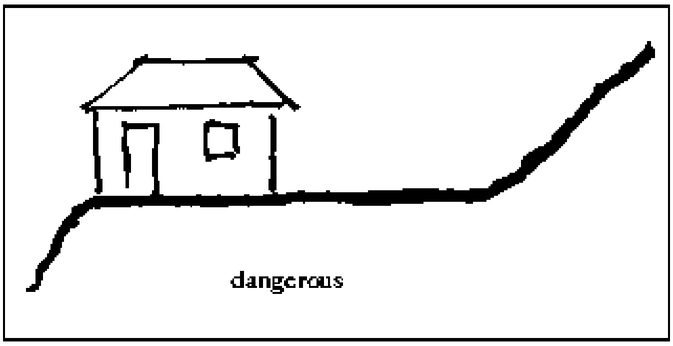
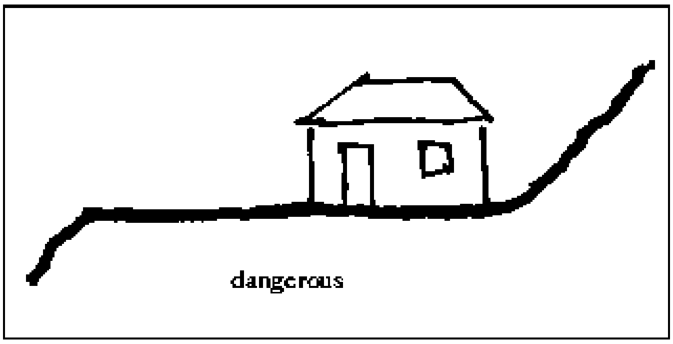


2–3



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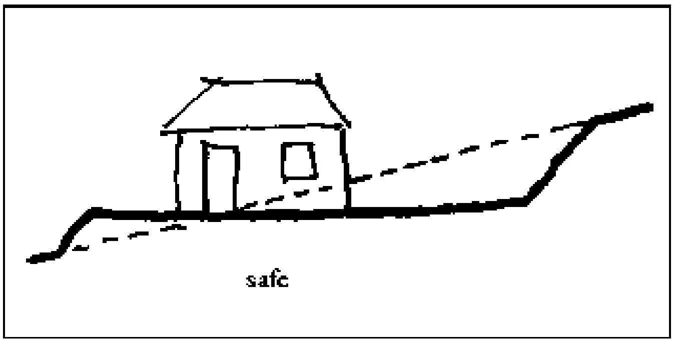


2–5

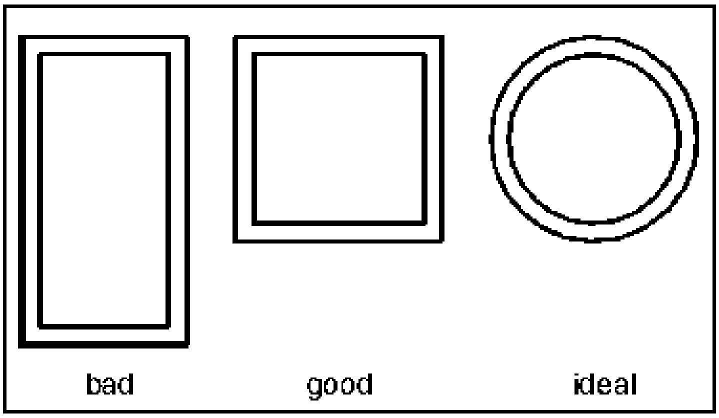
3. Shape of plan

The shape of the plan of the house might have an important influence on its stability. The following rules must be considered:

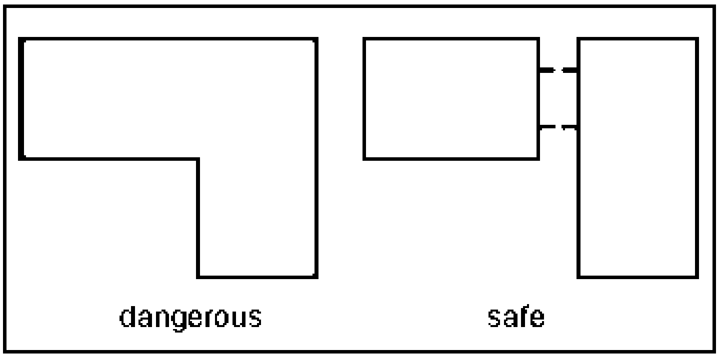
a) The more compact a plan, the better the stability. This means a square plan is better than a rectangular one, and a circle is better than a square.

b) L−shaped plans are less stable. The best solution in this case is to separate the elements as shown in Fig. 3−2.

At the University of Kassel a simple test method was developed within a doctorate thesis in order to show the influence of the wall shape on resistance to seismic shocks. A weight of 40 kg at the end of a 5.5 m long pendulum was dropped against the models, see Fig. 3−3. The rammed earth house with square plan showed the first large cracks after the second stroke, see Fig. 3−4. After three strokes one part of the wall separated, see Fig. 3−5, and after four strokes the house collapsed, see Fig. 3−6. The rammed earth house with circular plan, however, showed the first cracks only after three strokes, see Fig. 3−7, and only after six strokes did one small part of the wall separate, see Fig. 3−8 (Yazdani, 1985). Syed Sibtain built several houses in Afghanistan utilizing convex walls with buttresses, which give good stability similar to that of circular walls, see Fig. 3−9 (Sibtain, 1982). But the problem with all wall structures is that the openings weaken their stability. Therefore, openings must be carefully designed and often require additional reinforcement.



3−1 Ground plans



3–2


3–3 Simulation of seismic shocks (Minke 2000)

3–4 to 3–8 Earthquake tests with models of square and circular shape (Minke 2001)

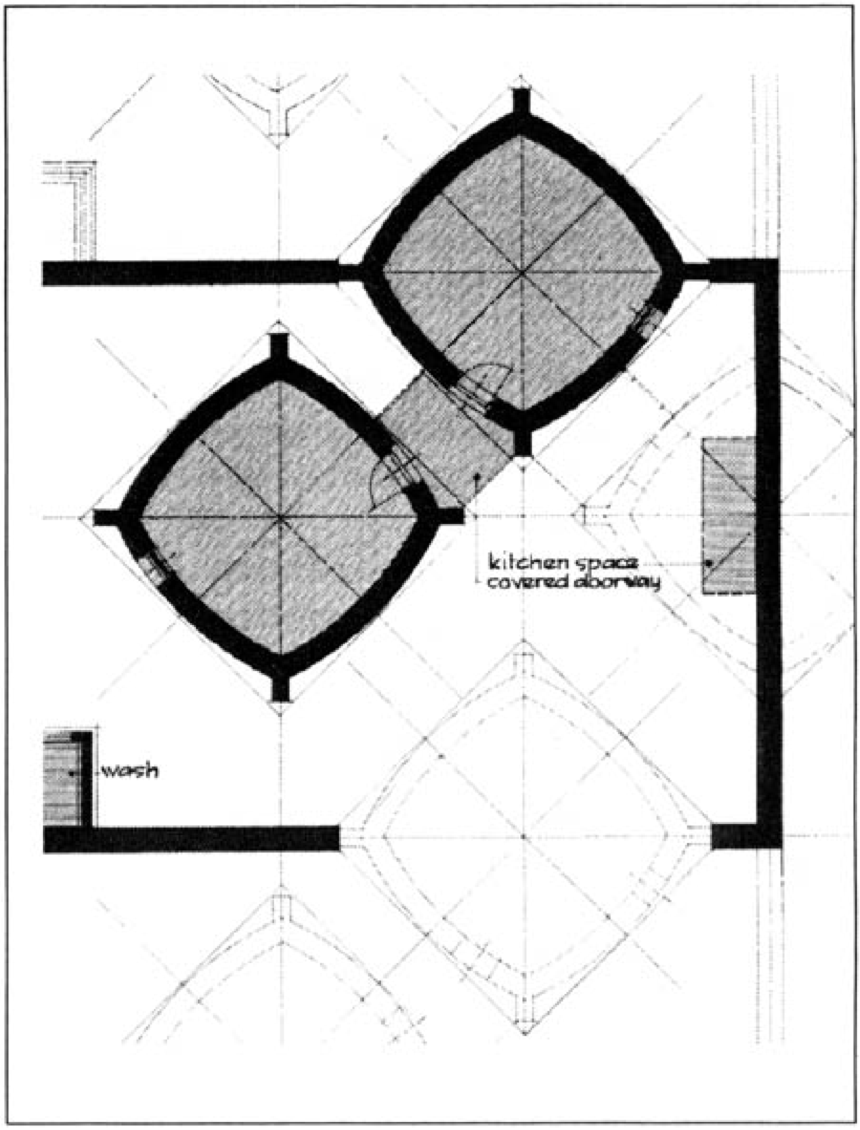

3–4

3–5

3–6

3–7

3–8



3–9 Plan of seismic–resistant houses, Afghanistan (Sibtain 1982)

4. Typical failures, typical design mistakes

Typical failures which occurred with simulated seismic movements on models in the scale of 1:5 are to be seen in Figs. 4–1 to 4–3. The most significant are:

– diagonal cracks lead from the edges of windows to the bottom of the wall,

– the lintel often destabilizes the walls, especially if it is not long enough and does not have sufficient bond with the wall,

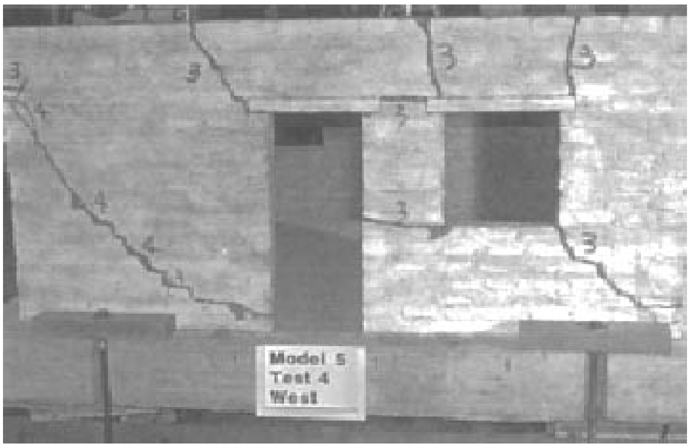
– if the wall between window and door or between opening and corner is not long enough, it might break,

– if the wall has no ring beam at the top it breaks easily when suffering perpendicular loads which produce bending.

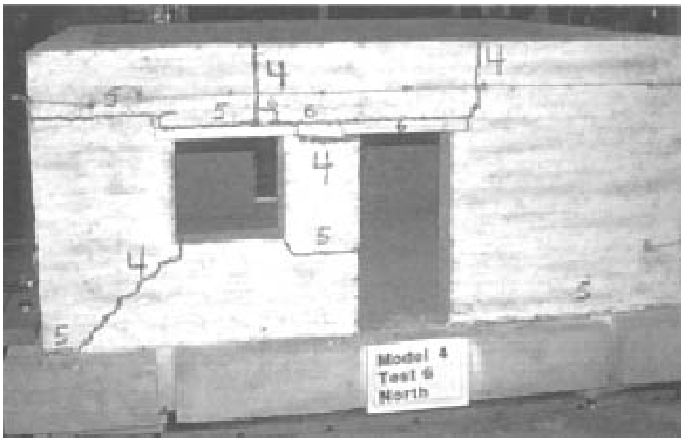
The houses shown in Fig. 4–4 seem to be well designed with the stabilizing buttresses at the corner. But without a ring beam they do not have sufficient stability against seismic shocks, as Fig. 4–5 and 4–6 show.

The 10 main structural mistakes which might lead to a collapse within an earthquake are explained in Fig. 4–7.

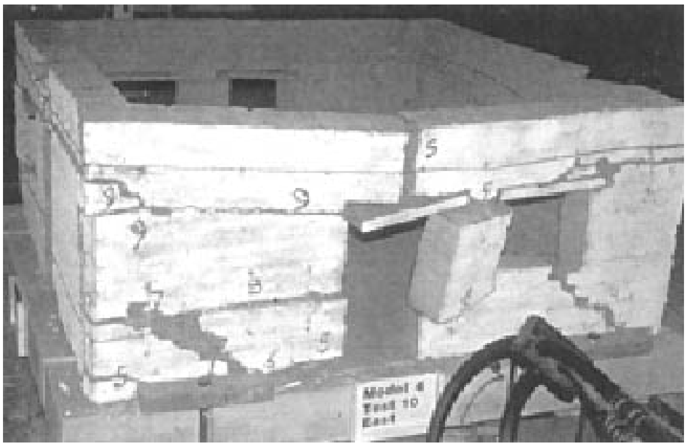
4–1 to 4–3 Typical failures caused by seismic movements (Tolles et al. 2000)



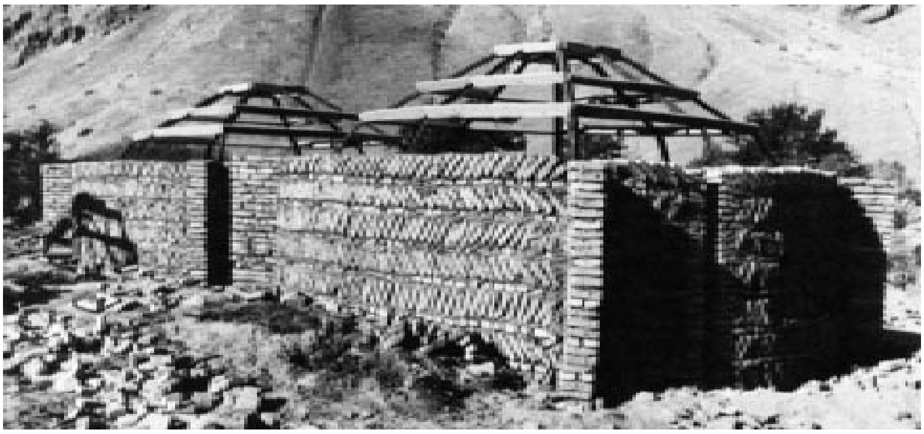
4–1



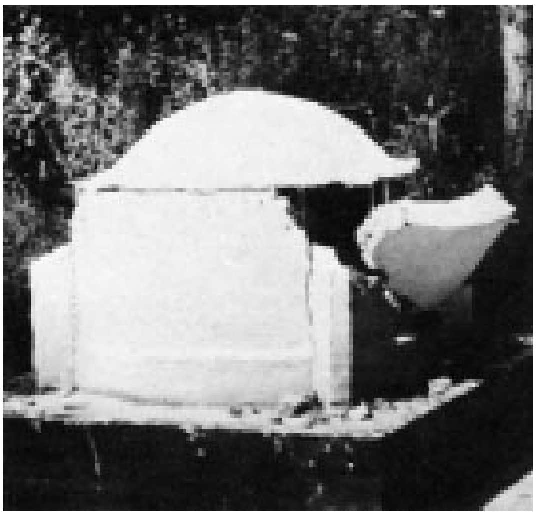
4–2

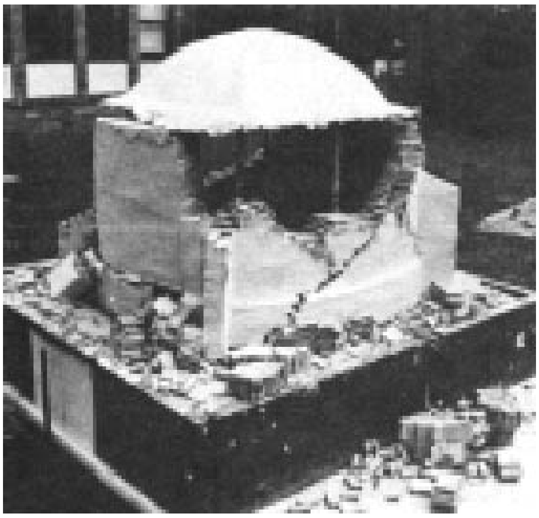


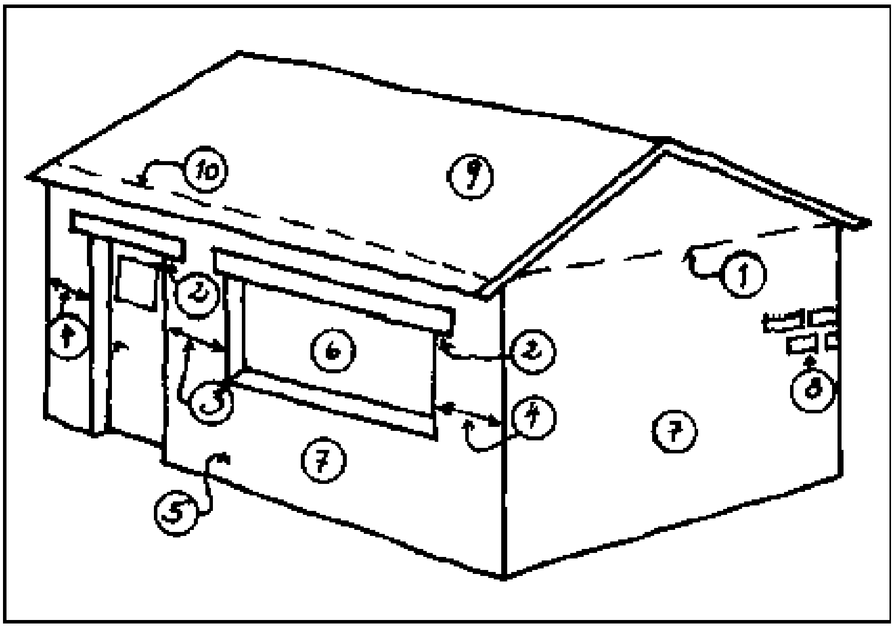
4–3


4–4 Earthquake–proof houses, Afghanistan (Sibtain 1982)

4–5 and 4–6 Models of the house in Fig. 4–4 after seismic movements (Sibtain, 1982)


4–5


4–6



4−7 Typical design mistakes which might lead to the collapse of the house

1. Ring beam is lacking.

2. Lintels do not reach deeply enough into masonry.

3. The distance between door and window is too small.

4. The distance between openings and wall corner is too small.

5. Plinth is lacking.

6. The window is too wide in proportion to its height.

7. The wall is too thin in relation to its height.

8. The quality of the mortar is too poor, the vertical joints are not totally filled, the horizontal joints are too thick (more than 15 mm).

9. The roof is too heavy.

10. The roof is not sufficiently fixed to the wall.

5. Structural design aspects

There are three general principles for designing an earthquake−resistant structure:

1. Walls and roof are well interconnected and so rigid that no deformation occurs in the earthquake.

2. Walls are flexible enough, so that the kinetic energy of the earthquake is absorbed by deformation. In this case a ring beam, which is able to take bending forces, is necessary and the joints between wall and ring beam and ring beam and roof must be strong enough.

3. The walls are designed as mentioned in case 2, but the roof is fixed to columns separated from the wall, so that both structural systems can move independently as they have different frequencies.

Case 1 can be a house with very thick rammed earth wall or a reinforced concrete frame structure with moment−stiff corners at the top and at the bottom, and infills of bricks, cement blocks or adobes.

A variation of a nonflexible structure is a timber frame structure which has less moment−stiff corners and is therefore stabilized by crossing diagonals of steel. In this case the danger exists that the connection of the diagonal or the elements itself may not be strong enough to withstand the concentration of stresses at the corner and breaks, causing the collapse of the wall, see Fig. 5−1.

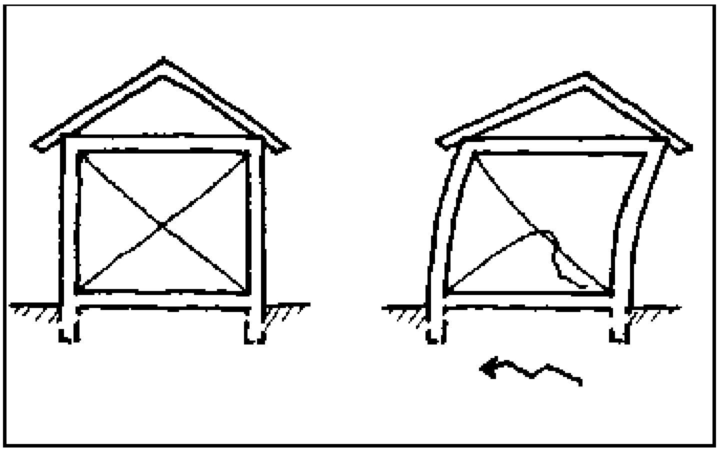
The systems of case 2 and 3 can be built without concrete and steel and in most regions are much more economic. Walls built with the system of "wattle and daub" (in Spanish: "bahareque" or "quincha") show extreme flexibility. Fig. 5−2 shows a house which suffered under a heavy earthquake in Guatemala, but did not collapse.

As the vertical forces created by the earthquake are less important, we have to decide how the walls withstand the horizontal forces. There are two types of impacts to be considered: those forces, which act parallel to the wall and those which act perpendicular to it. (Forces acting at an inclined angle to the wall can be divided into two components, one parallel and one perpendicular to the wall.)

The perpendicular forces create a moment which might provoke a collapse of the wall if it is not stabilized by intermediate walls, buttresses and ring beams. If the walls are very thin and high, they might collapse even though stabilized, due to the bending forces that create buckling. The parallel forces are less dangerous. They produce thrust within walls which in the case of adobe walls with poor mortar create the typical diagonal cracks, shown in Fig. 4−1 and 4−2.

The most dangerous effects result when the walls fall outwards and the roofs collapse. Therefore the safest solution is to place the roof on a separate structure independent of the walls, see chapter 12.

When designing earthquake−resistant houses, we must consider that the horizontal force ("equivalent force") to be calculated is proportional to the mass of the structure and the higher the walls, the higher their displacement.



5−1


5−2 Wattle and daub structure, after a heavy earthquake in Guatemala (Minke 2000)

6. Rammed earth walls

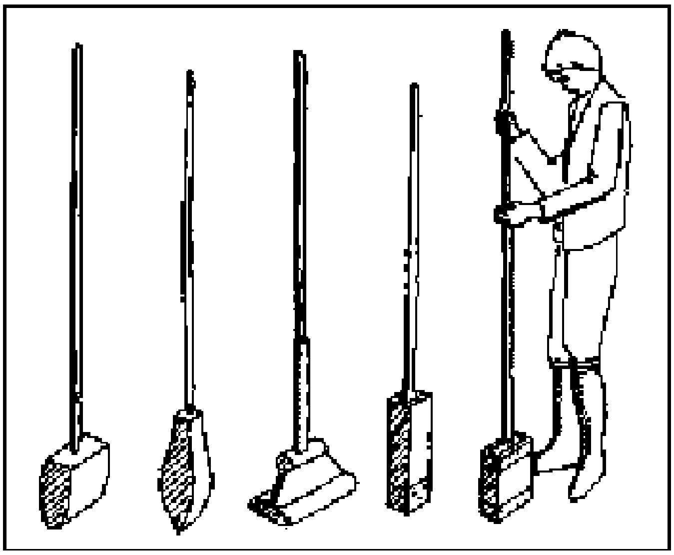
6.1 General

In the rammed earth technique moist earth is poured into a formwork in layers 10 to 15 cm thick and compacted by ramming. The formwork consists of two parallel panels, separated and interconnected by spacers, see Fig. 6−1. By comparison with adobe masonry, rammed earth walls provide more stability as they are monolithic.

Traditional techniques use formwork with big wooden spacers, which cause openings and weak parts and often show horizontal shrinkage cracks between the layers, as the fresh layer on top of the old one shows larger shrinkage.

To avoid both disadvantages a special formwork was developed at the Building Research Laboratory (FEB), University of Kassel, which is spaced only at the bottom by a very thin steel bar and on the top above the wall, see Fig. 6−4.

Traditional techniques use manual tampers with conical or flat heads, see Fig. 6−1. Conical tampers give a better bond between the different earth layers, but need more time. It is preferable to use a tamper with two heads, one with a round surface and the other with a square surface, see Fig. 6−2. The square tamper has to be used at the borders of the formwork. Pneumatic tampers and stronger formwork, as used nowadays for instance in Australia, can reduce the labor input by the factor of 10. (For further details see: G. Minke: Earth Construction Handbook, WIT Southampton, UK 2000)

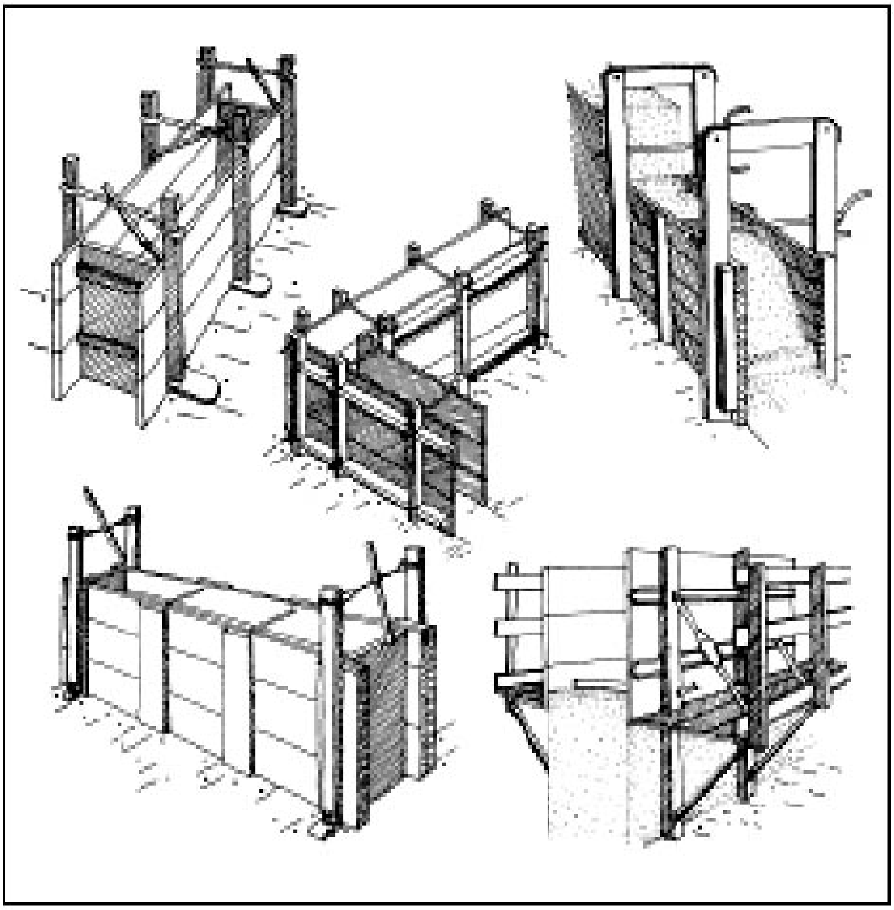


6−1 Manual tempers (Minke 2001)

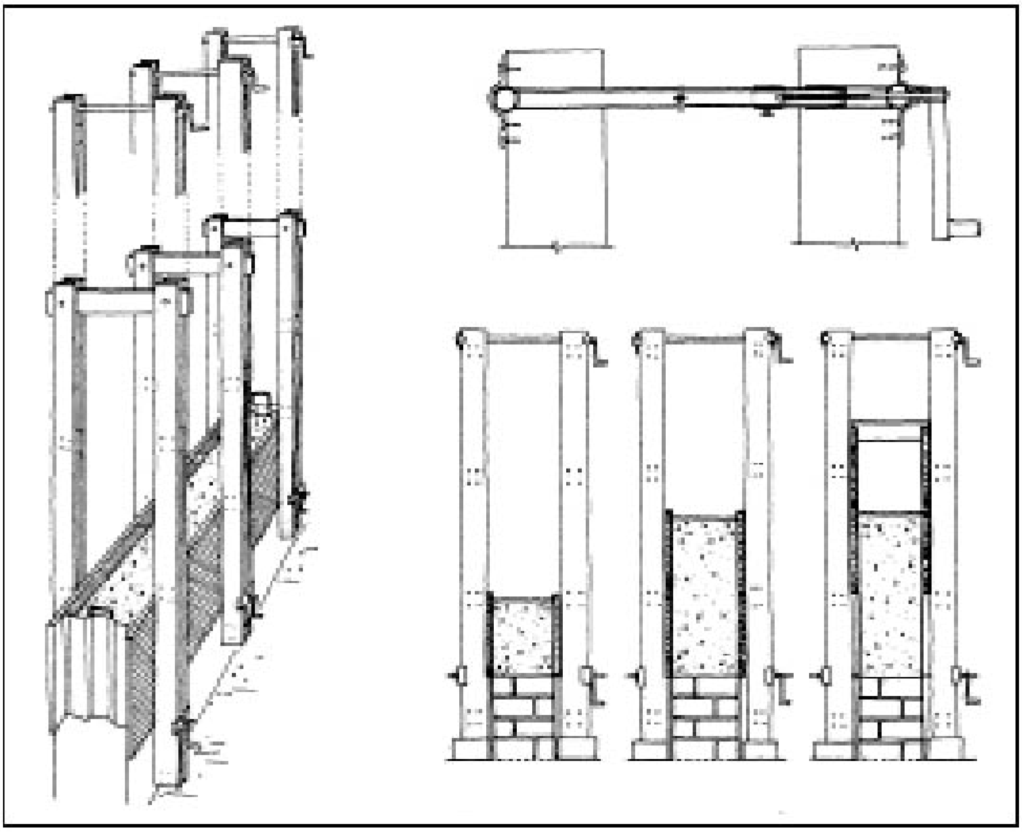
6−2 Temper with two «heads», used in Ecuador (Minke 2001)

6.2 Stabilization through mass

Rammed earth walls 60 to 100 cm thick, which are not too high, can withstand horizontal seismic shocks without additional old age withstood all earthquakes, whereas newly constructed houses next to them collapsed, even when they were built with bricks and a concrete ring beam. As thick rammed earth walls are too labor−intensive and no longer affordable nowadays, new structural solutions have to be used, as set out in the following chapters



6–3 Formwork for rammed earth (Minke 2000)

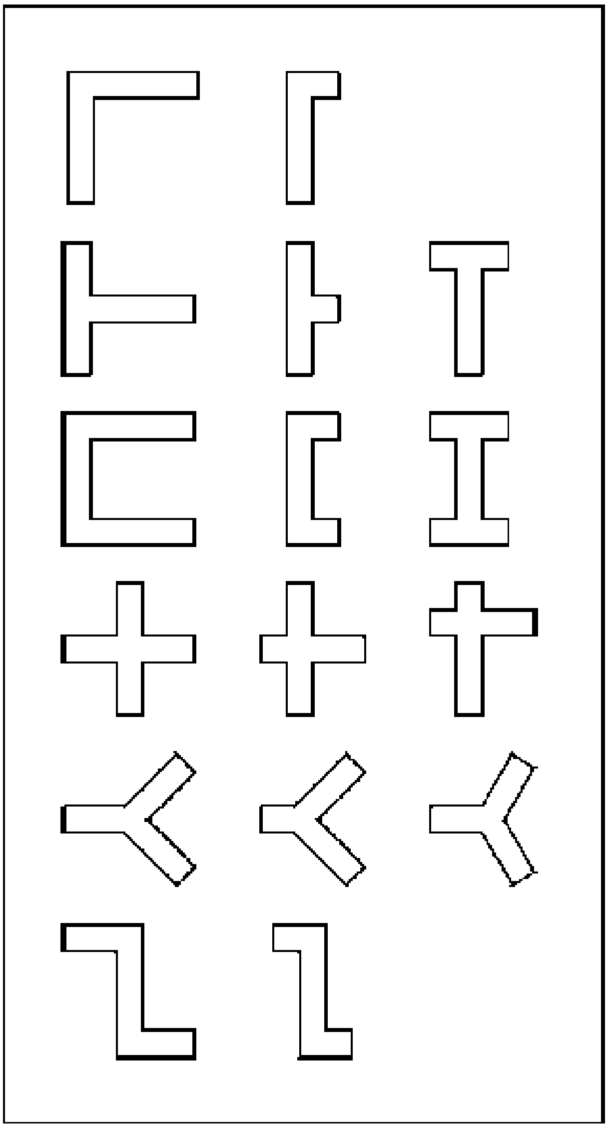


6–4 Climbing formwork (Minke 2000)

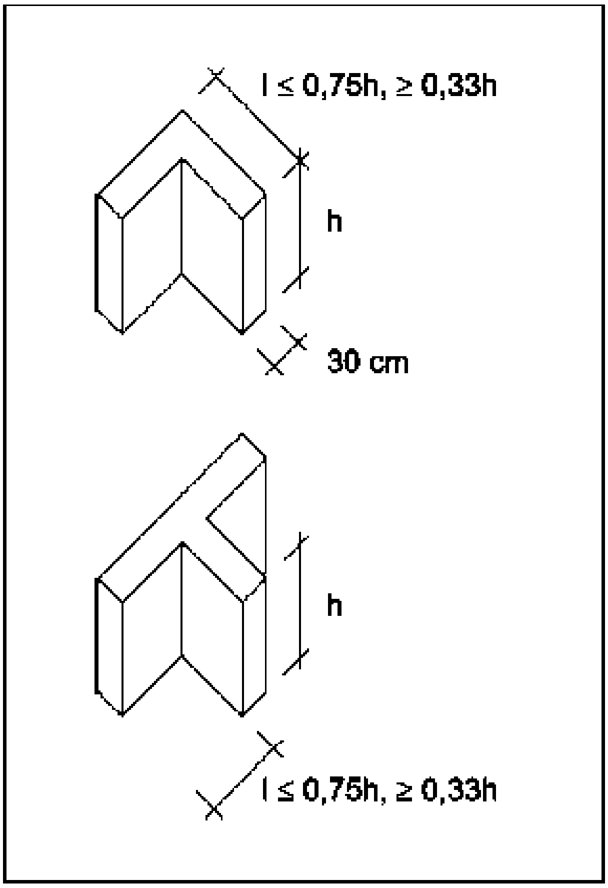
6.3 Stabilization through shape of elements

A simple solution for stabilizing rammed earth walls of lesser thickness is to use elements in the shape of L, T, U, X, Y or Z (Fig. 6−5). Due to their angles they show better stability against lateral forces. If the wall is 30 cm thick, the free ends of the elements should not be longer than 3/4 and not shorter than 1/3 of their height, see Fig. 6−6. This minimal length is necessary to transfer the loads diagonally to the plinth or foundation. If the free ends are longer than 3/4 of its height, they should be stabilized by another angle. If the angle is well fixed on the bottom to the plinth and on the top to a ring beam, it can be larger or higher. Nevertheless, the height should not be more than 8 times the width, see Fig. 6−7.

The forces perpendicular to the wall are transferred into the angle which is parallel to the direction of the force. This means it is transferred versus a moment which creates stress concentration at the inner corner of the angle.



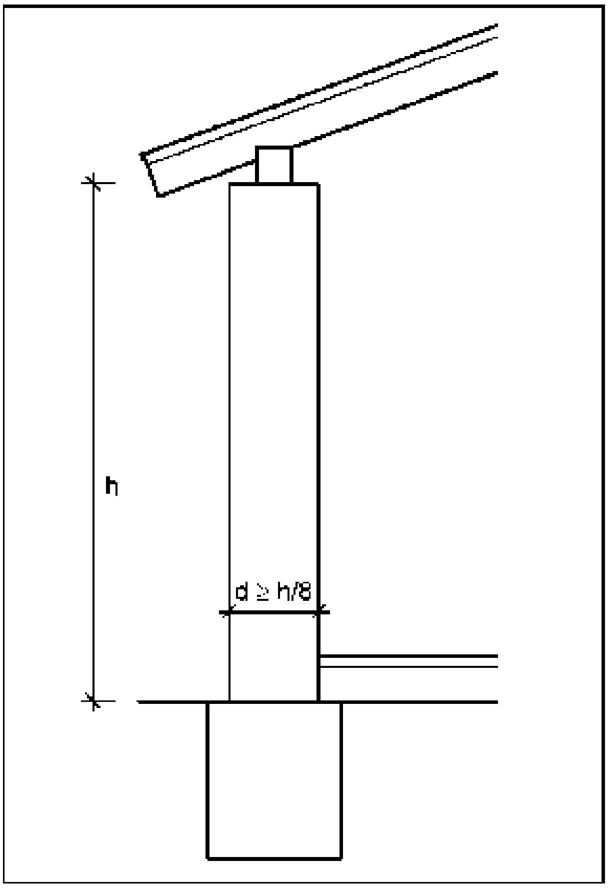
6−5 Wall elements stabilized by their shape



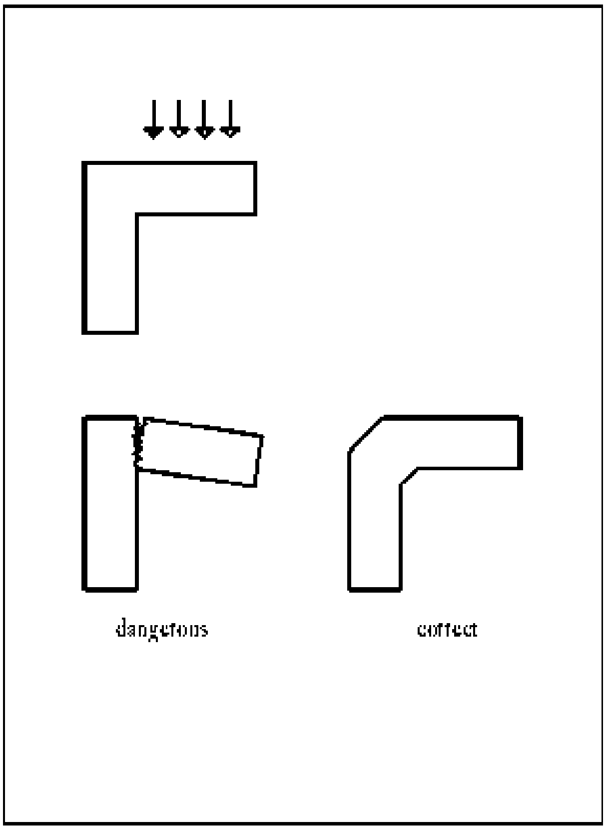
6−6 Recommended proportions

Therefore it is advisable to enlarge the section at this corner, shown in Figs. 6−8 and 6−9. Fig. 6−12 shows different proposals for plans utilizing angular elements.

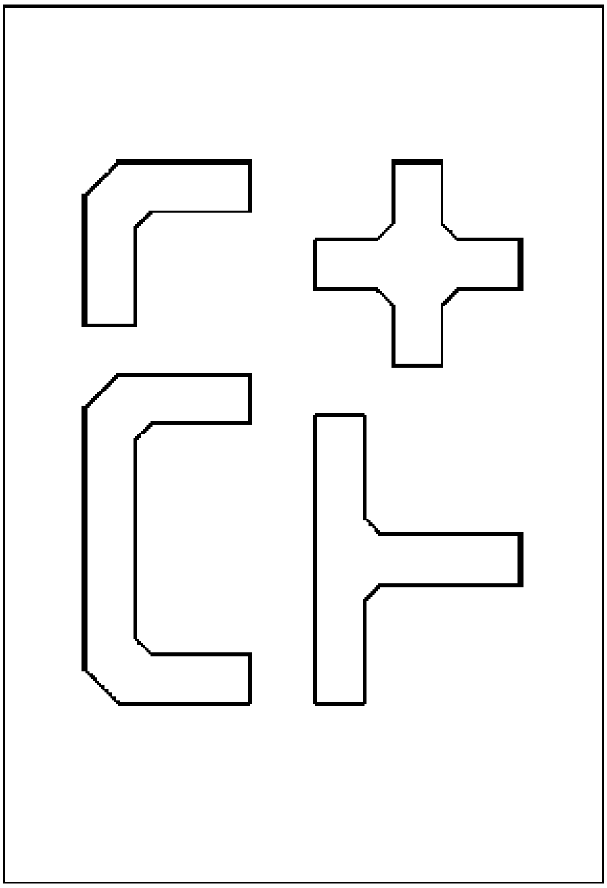
To improve lateral stability the joint of two elements should be formed with tongue and groove, see Fig. 6−10. However, in order to obtain a more flexible structure, elements with shorter length and no tongue and groove joint should be used (Fig. 6−11), if the elements are well linked to a ring beam above and to a plinth below. This kind of solution is used in the project described in chapter 6.4.



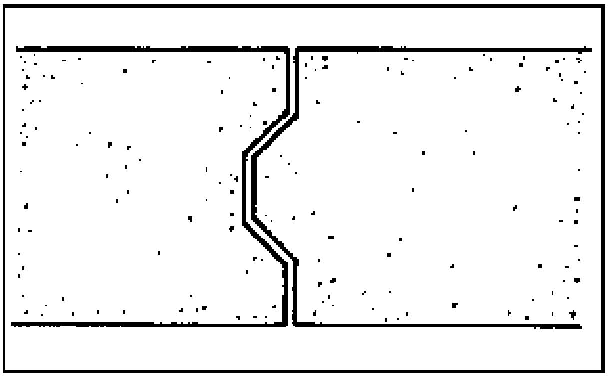
6–7 Expedient proportion of wall



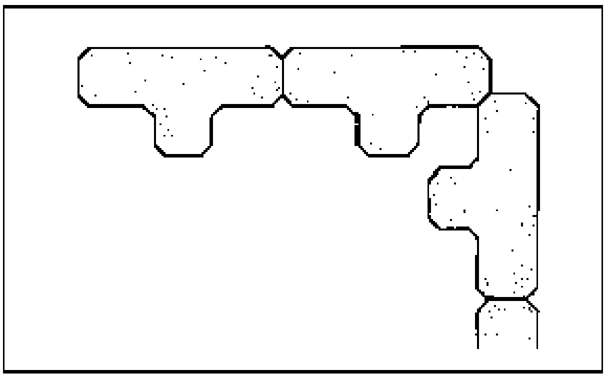
6–8 Corner solution



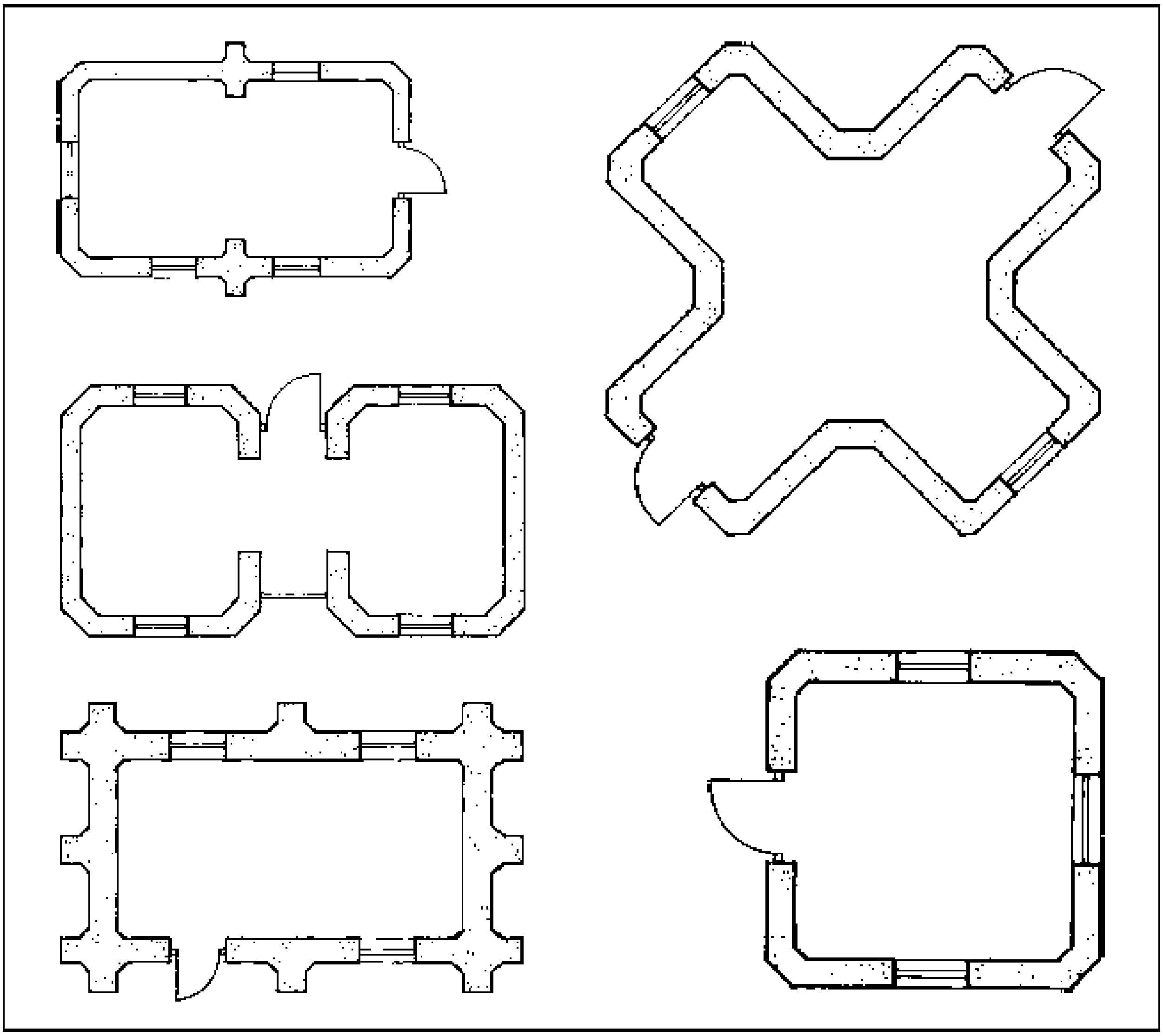
6–9 Elements with correct corner details



6–10 Joint with lateral stability



6–11

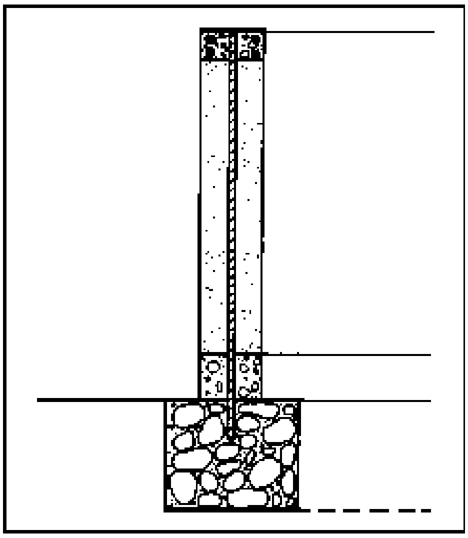


6−12 Proposals for simple plans utilizing angular elements

6.4 Internal reinforcement

One method of stabilizing rammed earth walls against horizontal forces is to use vertical rods of bamboo or wood inside the wall. These elements should be fixed to the foundation below and to a ring beam above, see Fig. 6−13. Horizontal reinforcement elements usually weaken the structure and lead to horizontal cracks, as shear forces cannot be transferred by the rods, since the bond between these elements and the earth is very poor. Furthermore in practice it is difficult to ram the earth well underneath these elements, due to their elastic behavior when hit.

A new system utilizing bamboo as vertical reinforcement for element−type rammed earth walls was developed in 1978 at the FEB and successfully implemented together with the University Francisco Marroquin (UFM) and Centre of Appropriate Technology (CEMAT), both from Guatemala. The low−cost housing prototype built is depicted in Figs. 6−14 to 6−19. The wall elements were rammed in a metal T−shape form, 40 cm high, 80 cm large and 14 respectively 30 cm wide, see Figs. 6−16 and 6−19. The rib plays an important role in the stabilization of the element against horizontal forces, as it acts like a buttress. The elements are reinforced by 4 vertical bamboo rods of 2 to 3 cm diameter. The bamboo rods were fixed at the bottom to the horizontal bamboo ring beam and the stretched vertical rods of the plinth, see Fig. 6−14.



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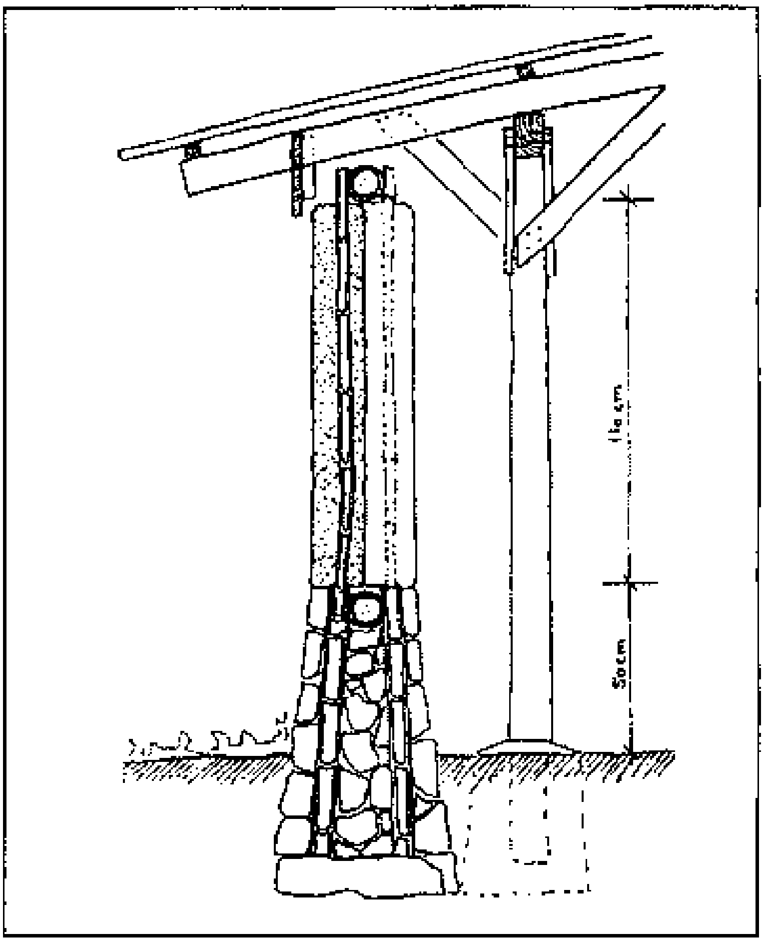

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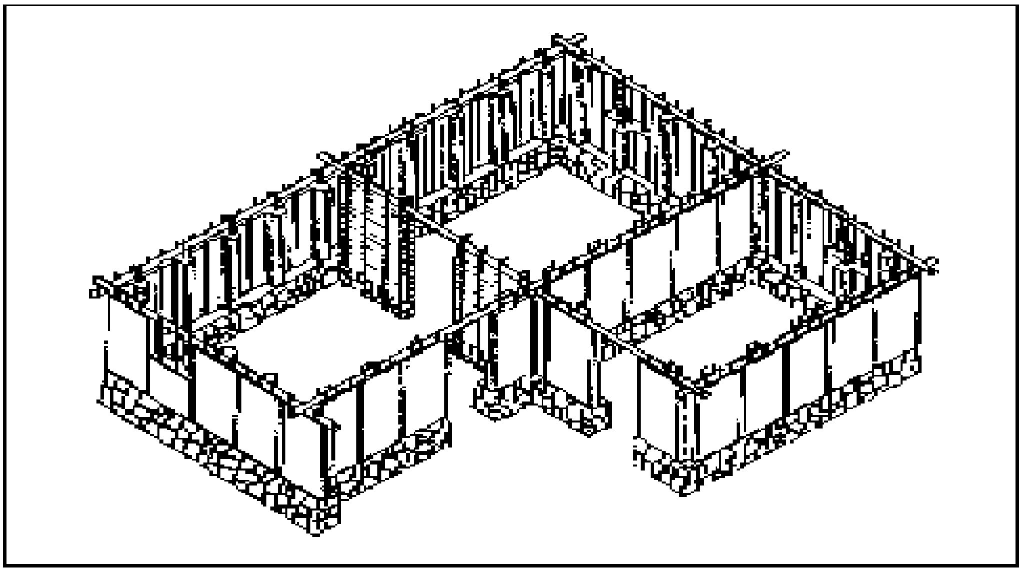

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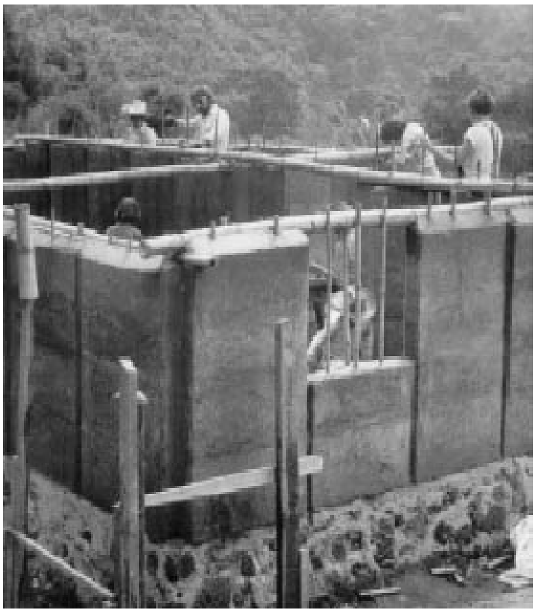
6–16



6–17

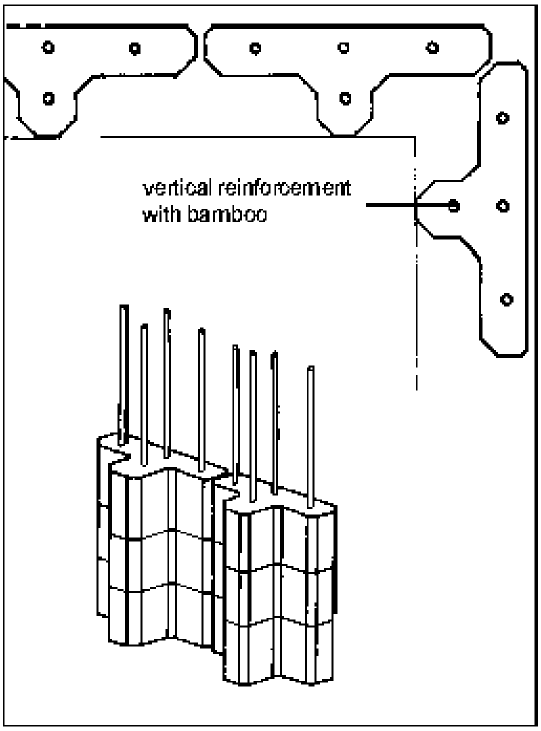
After drying vertical gaps of 1 to 2 cm appeared between the elements, which were then closed by earth. These vertical joints are predesigned rupture joints which can crack in an earthquake and allow independent movements of each element. So the kinetic energy of the seismic shock will be absorbed by deformation, but the element being fixed at the top and bottom will not fall. After the earthquake the open joints can easily be closed again with earth. Using this idea an earth wall system was developed, which is massive and flexible at the same time. The second new fact with this prototype structure was that the roof rests on posts standing 50 cm inside the walls, so that the roof and the walls can swing independently of each other within the earthquake.

6−18

In 1998 the FEB developed another reinforced rammed earth wall system which was utilized for a low−cost housing project built in cooperation with the University Santiago de Chile in 2001 in Alhué, Chile, see Figs. 6−20 and 6−21. Here too the idea was to separate the roof from the wall system and to use U−shape and L−shape elements, which stabilize themselves by their shape.

The corners of the angular elements were cut under 45 degrees in order to increase their strength as described in chapter 6.3. To obtain additional stabilization they were reinforced by vertical rods of colligue (similar to bamboo), 3 to 5 cm in diameter. Furthermore, the wall elements were always separated by light, flexible elements, or doors and windows. The lower parts of the windows and the parts above the doors were not built with massive elements, but instead of light timber elements. The gables were built in lightweight straw−loam stabilized by wooden elements, similar to the wattle and daub system.

6−14 to 6−19 Earthquake resistant low−cost housing project, Guatemala (Minke 2001)



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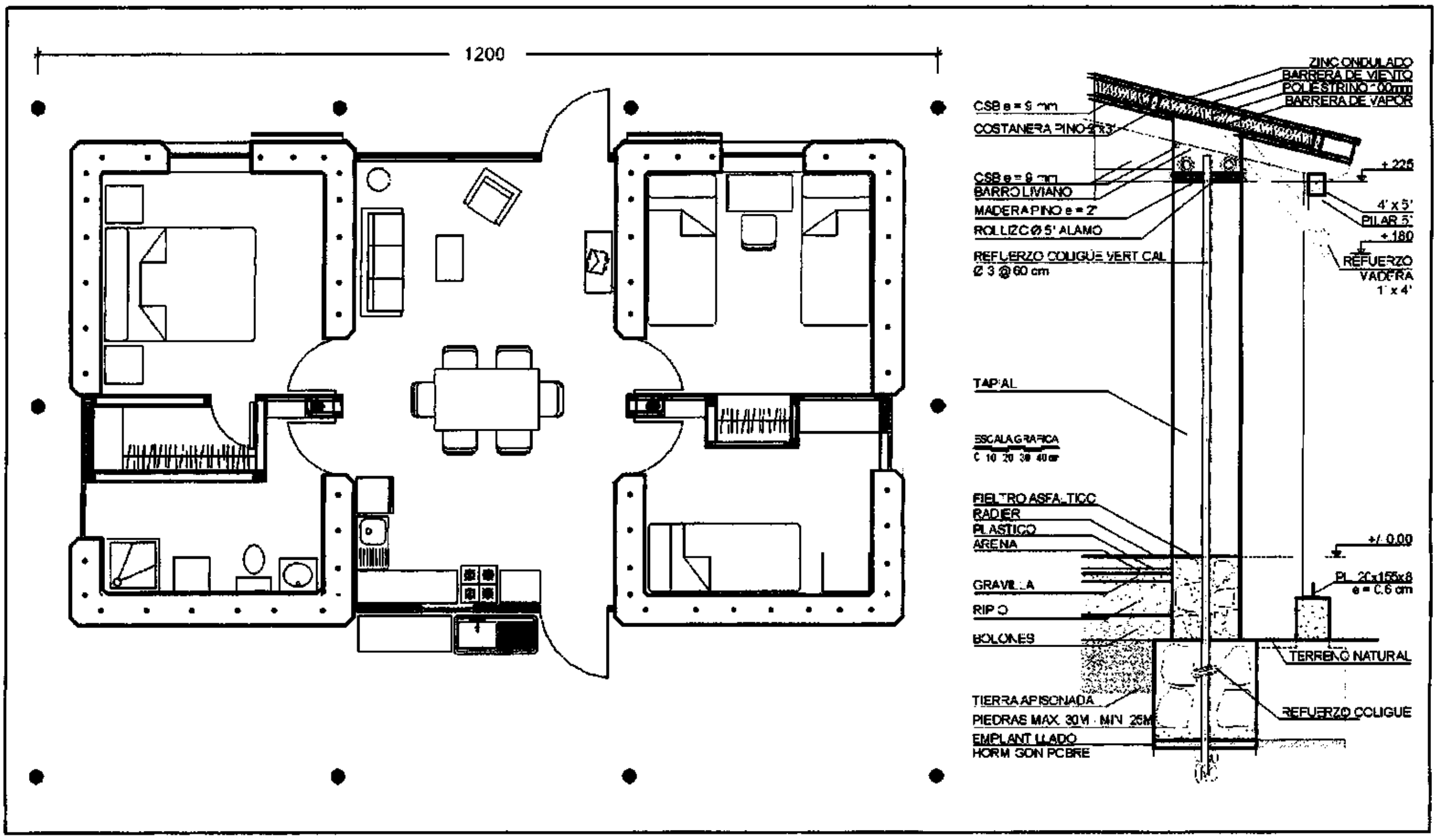


6–20 and 6–21 Earthquake resistant prototype building, Alhué, Chile 2001

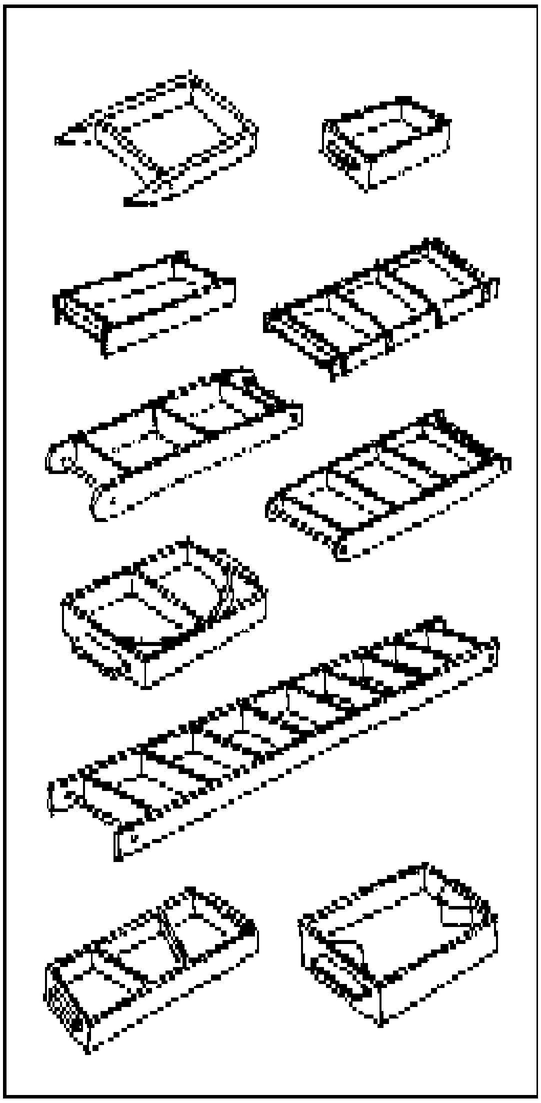
7. Adobe walls

7.1 General

Blocks of earth produced manually by throwing wet earth into a formwork are called adobes, or mud bricks or sometimes sun−dried earth blocks. When moist earth is compacted in a manual or powered press, the compressed elements so formed are called soil blocks. Blocks produced by an extrusion process in a brick plant, are called green bricks in their unburnt state. Larger blocks compacted in a formwork by ramming are called rammed earth blocks.

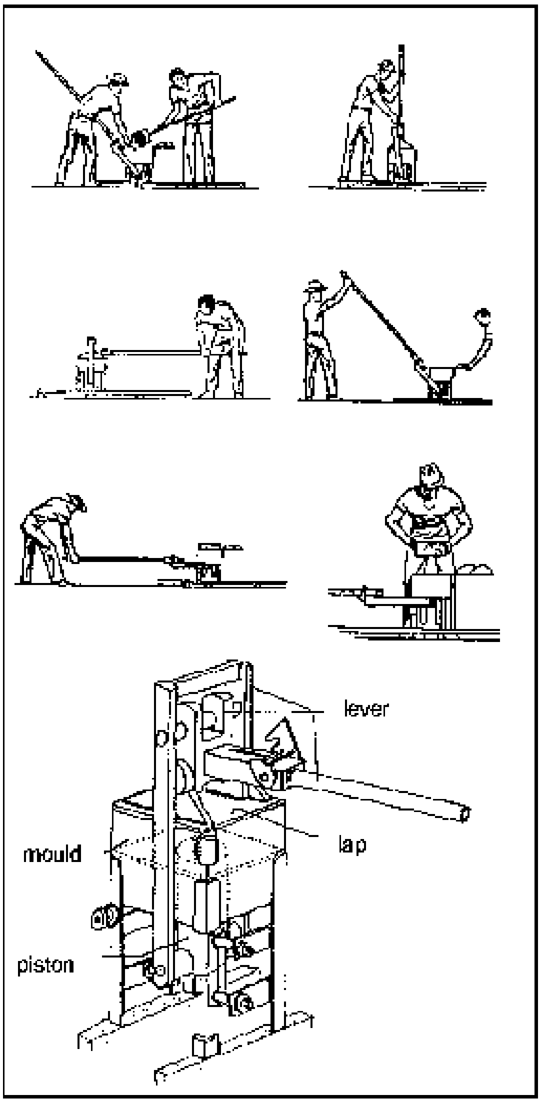
There are many different shapes known all over the world. Fig. 7−1 shows some samples.

Different manually operated presses are known too. Fig. 7.3 shows one of the first, the widespread CINVA−Ram, and Fig. 7−4 the CETA−Ram, which can produce 3 smaller blocks at the same time. Blocks produced by these presses have the advantage of a more exact shape with sharp corners than handmade adobes. Their disadvantages are that they usually need the addition of 4−8% cement to the soil in order to obtain sufficient stability and that the production output is only half by comparison with adobes.



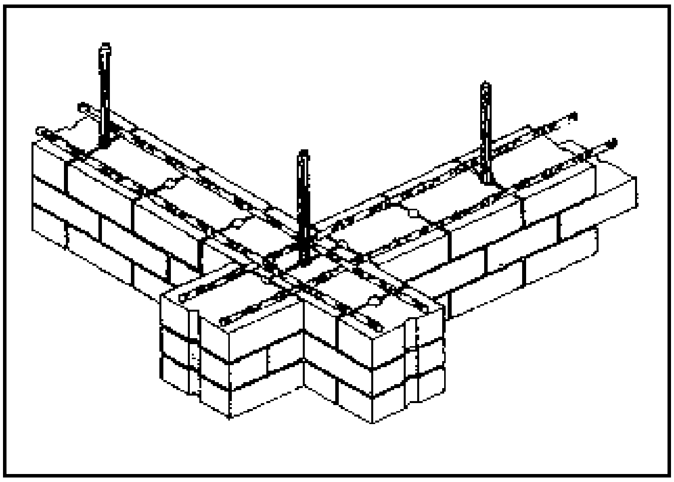
7−1 Adobe forms (Minke 2000)

7−2 Production of adobes in Ecuador

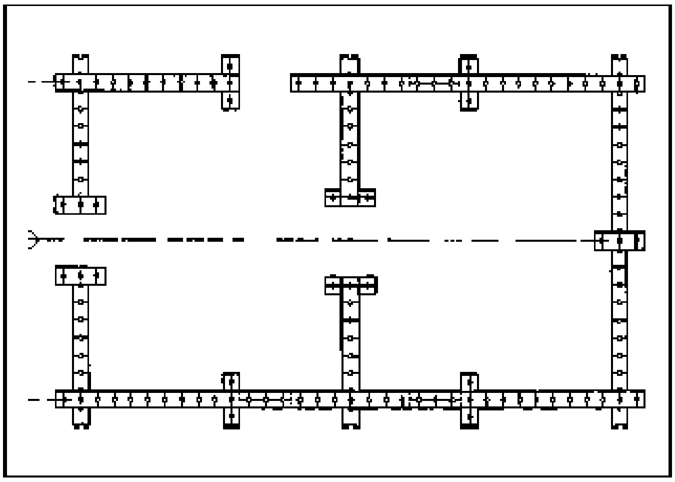


7−3 CINVA−Ram, Colombia

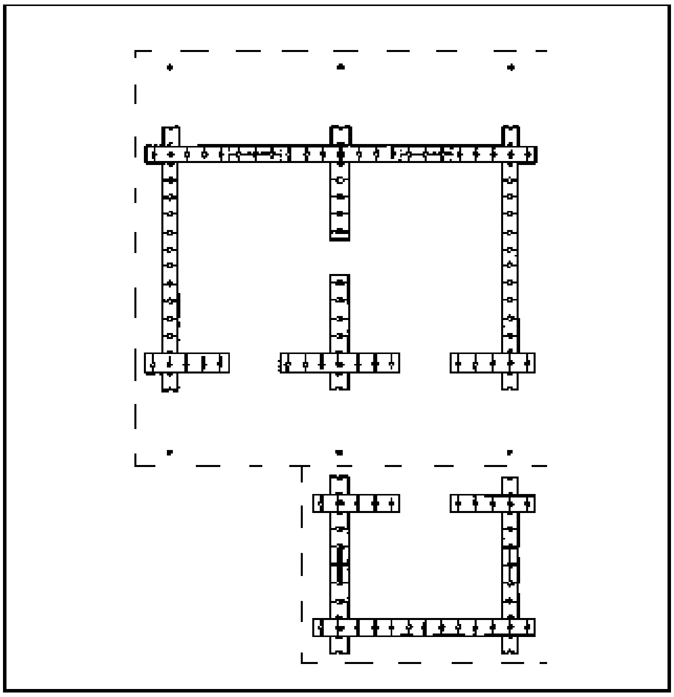

7−4 CETA−Ram, Paraguay



7−5 System ININVI, Peru



7−6 Ground plan with system ININVI, Perú (Pereira 1995)



7−7 Improved ground plan with system ININVI, (Equipo Maiz, El Salvador 1995)

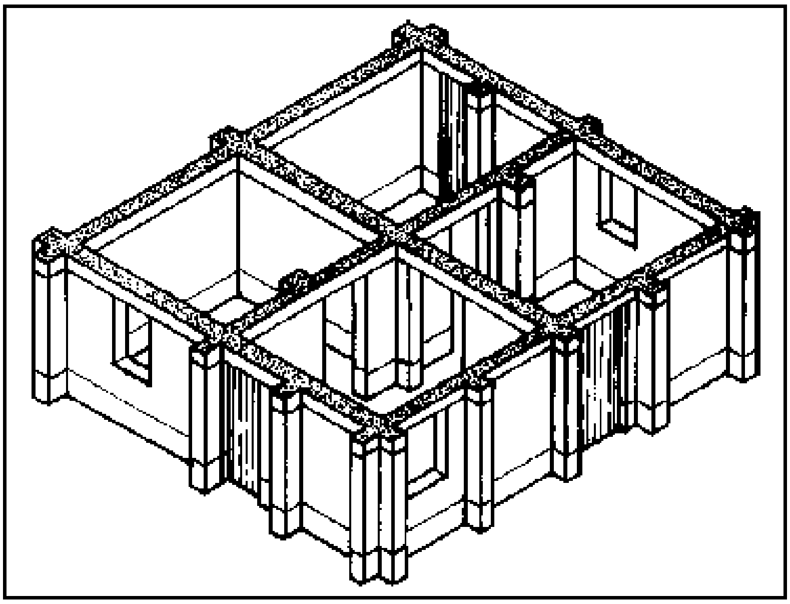
7.2 Internal reinforcement

The "Instituto nacional de investigación y normalización de la vivienda (ININVI), Peru, developed a system of adobe walls which are stabilized by vertical bamboo rods that fit into holes of 5 cm diameter, formed by grooves at the side of square adobes and halved ones, see Fig. 7−5. Corner buttresses and intermediate buttresses stabilize the wall, see Fig. 7−6. In Fig. 7−8 it can be seen that the horizontal elements of the roof trusses rest on and are fixed to the buttresses. It is important to mention that if the length of a wall is 12 times larger than its thickness, it should have an intermediate buttress, see Fig. 7−6 and 7−9. Interior walls must also have a buttress when they meet the exterior walls. Fig. 7−7 shows a simple design with shorter walls and a separate kitchen built in Salvador (Equipo Maiz, 2001).

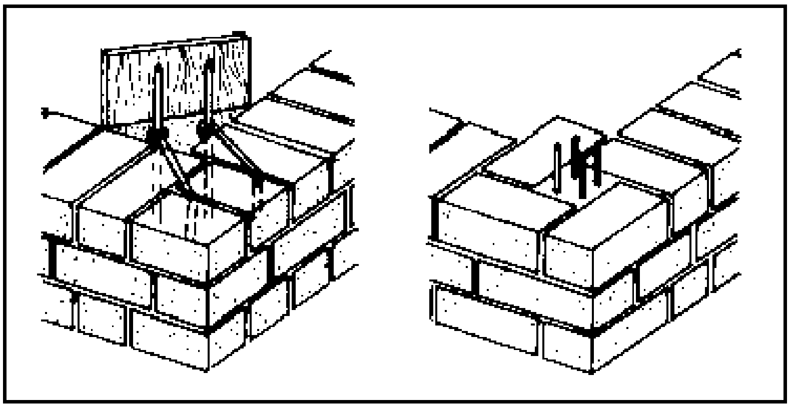
Horizontal bamboo rods, as shown in Fig. 7−5, normally do not strengthen the structure. They weaken the walls as they disturb the transfer of shear forces. This is due to the fact, that in practice there is not sufficient bonding between the rods and the adobe, as they are not always covered by 2 cm of mortar and as the quality of the mortar is too poor to take the shear forces.

The buttresses at the corners can be substituted by columns of reinforced concrete, see Fig. 7−10. In the case of the solution shown on the left, it is necessary to place horizontal steel bars at least every 50 cm which grip into the joints with their angles. This detail was forgotten in all publications which illustrate this solution. Without this bond, the column will separate from the wall when strong horizontal shock occurs in the earthquake.

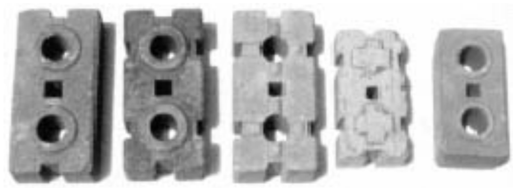
7−8 Educational centre Acomayo, Perú (Pereira 1995)



7−9 Adobe walls reinforced by buttresses



7−10 Stabilized corners



7−11 Interlocking blocks (Weinhuber 1995)

7−12 and 7−13 Prototype house, Thailand 1984 (Weinhuber 1995)


7−15 Improved interlocking system of FEB, Kassel, 2001

7.3 Interlocking blocks

Walls without mortar can be built with interlocking blocks. The blocks have holes for vertical reinforcement elements from steel rods or bamboo canes fixed by pouring cement sludge into the holes. The blocks are pressed in special molds and normally stabilized with cement, see Fig. 7−11. If they have enough vertical reinforcement elements, at least at corners and intersections, and if these are well fixed to the plinth and the ring beam, these walls are supposed to be earthquake−resistant due to their flexibility. The system was developed at the Asian Institute of Technology, Bangkok. Figs. 7−12 and 7−13 shows the first demonstration building, built in 1984 in Thailand. In this case the holes were filled with a mixture of cement and sand in the ratio 1:3.

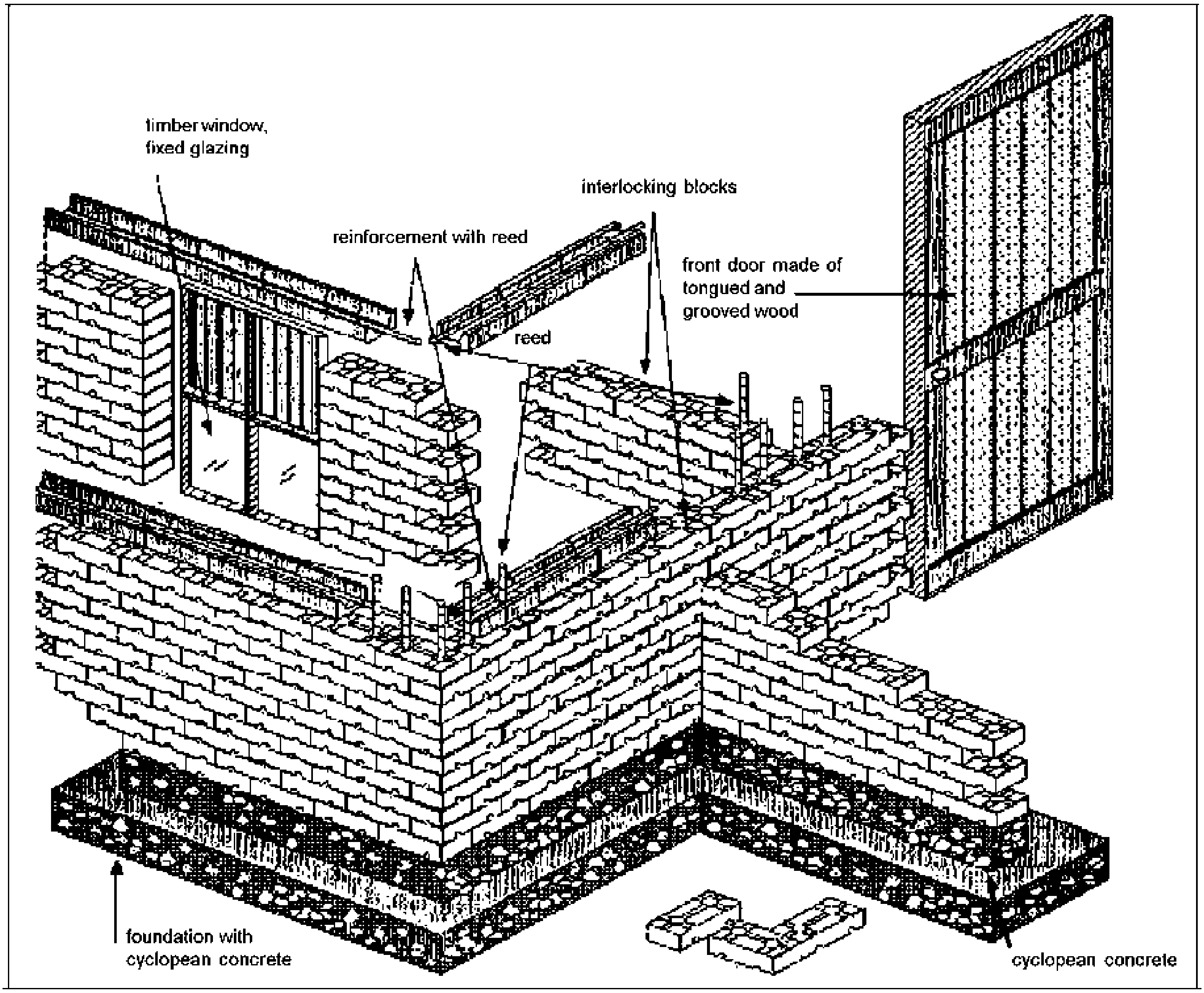
Fig. 7−14 shows a similar system, developed by the University of the Andes, Mérida, Venezuela. The blocks have grooves and tongues which interlock. Horizontal ring beams of reinforced concrete are placed at a height of 1.20 m and on top of the wall.

If stacked without mortar these walls do not show any high resistance to horizontal forces as the interlocking effect is only given by a height of some millimeters.

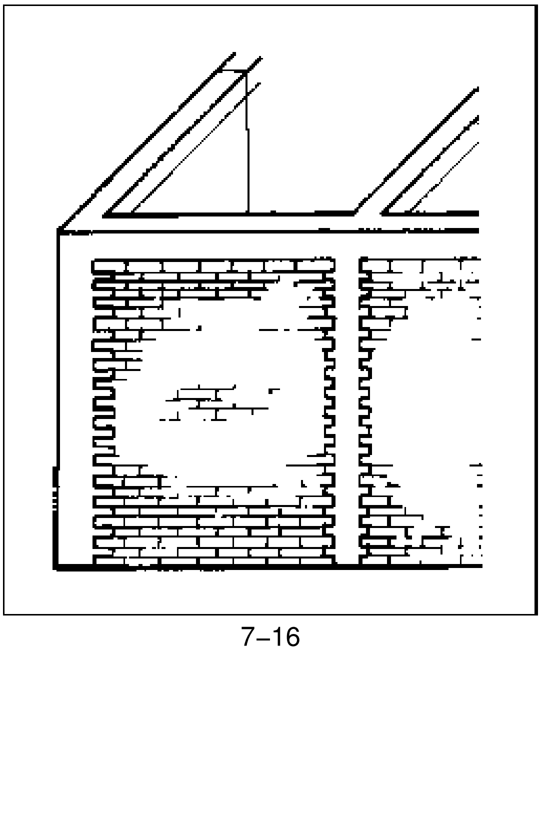
Therefore the author developed an improved interlocking system, with blocks showing tongues and grooves 40 mm high, in horizontal as well as in vertical joints, see Fig. 7−15. If these blocks are displaced or lifted up by seismic shocks, they always fall back into their normal position. The holes act as gripholes for easy 0 handling, but can also be used to install vertical reinforcement elements. But these additional reinforcement elements are not necessary if the wall corners are formed by concrete columns, which interlock with the block as shown in Fig. 7−15, and these columns are interconnected by a ring beam.

7.4 Concrete skeleton walls with adobe infill

Normal masonry walls are not very stable against seismic shocks. Therefore, nowadays the masonry walls are often framed by concrete which forms a skeleton structure with adobe (or brick) infill, see Fig. 7−2 and 7−3. The vertical concrete columns should have 4 steel bars of at least 14 mm diameter. It is important that the concrete and the adobes interlock, as shown in Fig. 7−16. For low−cost housing projects this solution is normally too expensive. Moreover it shows hardly any flexibility.



7–14 Building system invented by Universidad de los Andes, Mérida, Venezuela (Pereira 1995)



7–16

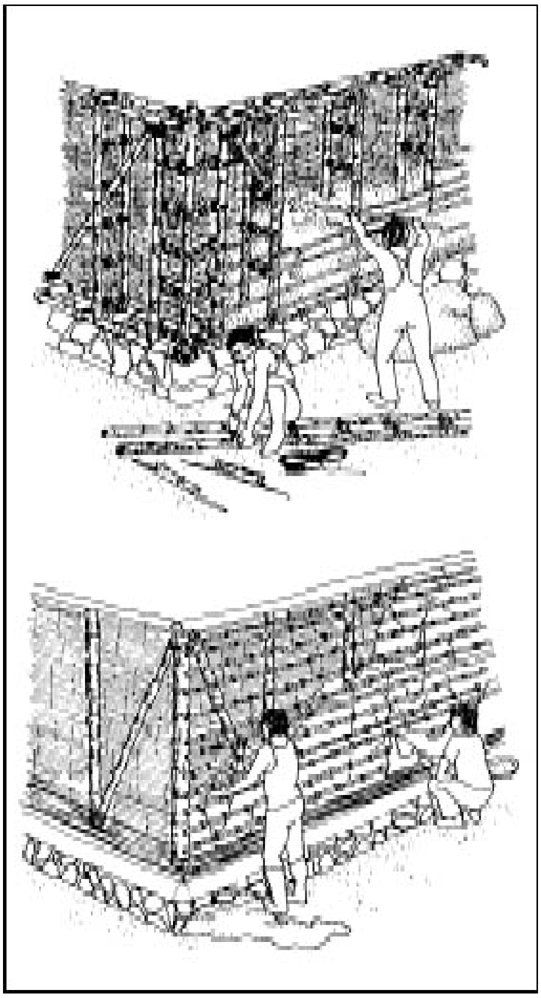
8. Wattle and daub

The wattle and daub wall system, which is called bahareque or quincha in Latin America, consists of vertical and horizontal elements made of timber or bamboo, forming a double layer grid which is filled with earth. Single−layer systems also exist, see Fig. 8−1. The vertical elements are usually tree trunks, the horizontal ones bamboo, reed or twigs. This is the most flexible system, as it is basically a timber grid structure with flexible joints and earth infill.

The disadvantage of this system is that it needs a lot of maintenance, as it cracks easily due to the thin cover of the wood elements and the swelling and shrinking of the wood. In practice there are often cracks and holes, where erosion starts and where insects can live; for instance in Latin America those that create the "decease mal de chagaz". Fig. 8−3 shows a system, developed by CEPED, Camari, Brazil, with prefabricated wall elements, to be filled locally with earth. The design in Fig. 8−4 by the architects Kühn, Poblete and Trebilcock show an interesting combination of rammed earth columns and wattle and daub intersections. This design was developed during a workshop on earthquake−resistant house design, sponsored by DFG and held by the author in 1998 at Santiago de Chile.

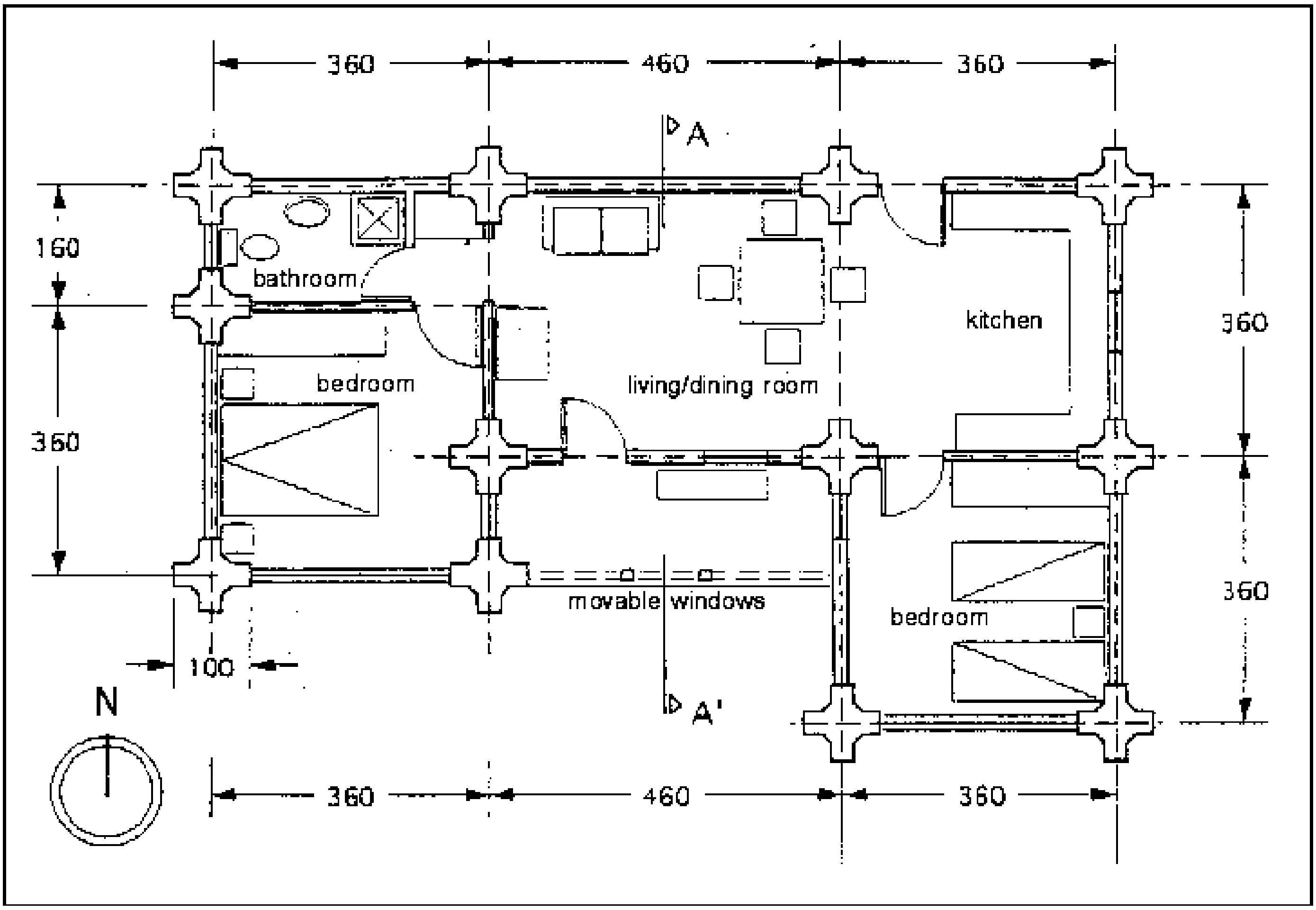
A very poor, unstable solution is shown in Fig. 8−5, sometimes built in Latin America after earthquakes as a quick solution to create shelter. The timber frame walls are filled with adobes, mounted upright and held by barbed wire on both sides. As the distance between the vertical posts is too large and the wires are not tightened enough, the adobes easily fall down.

8−1 Traditional wattle and daub system, Venezuela (Minke 2001)

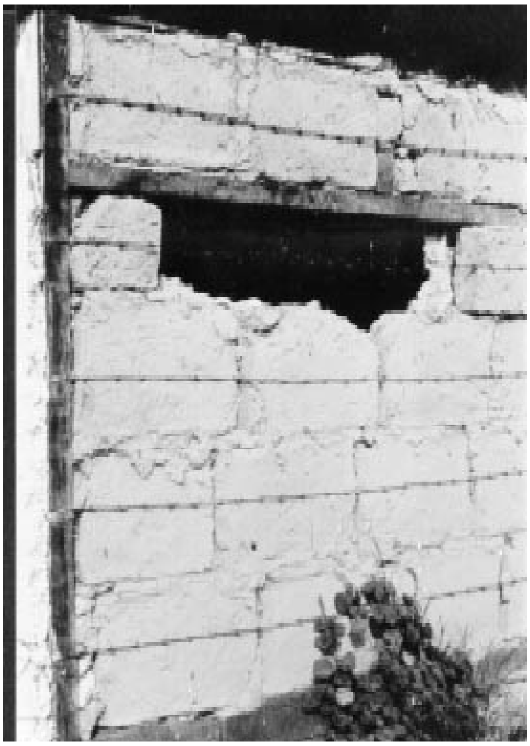


8–2 Wattle and daub systems (after Vorhauer 1979)

8–3 Prefabricated system CEPED, Brasil



8–4

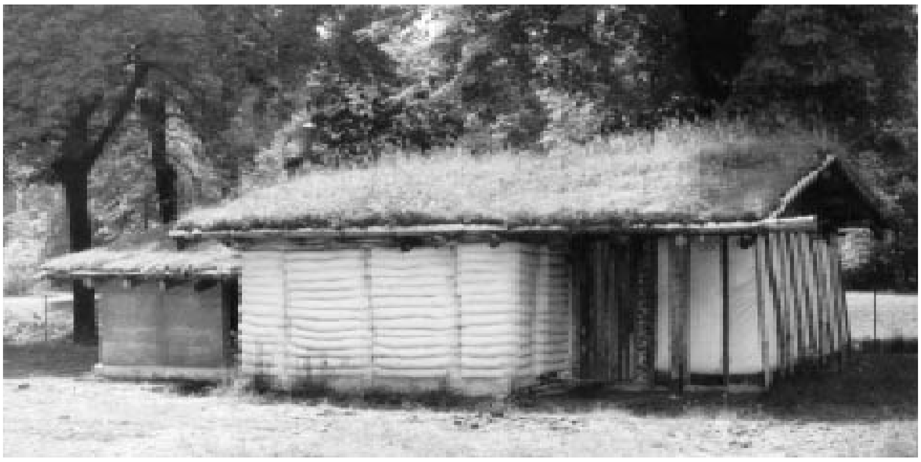


8–5 Dangerous solution, Chile

9. Textile wall elements filled with earth

At the Building Research Laboratory (FEB), University of Kassel, different solutions using textile earth−filled elements for walls were tested. Fig. 9−1 shows a prototype building, built in 1978 in Kassel. The wall consists of hoses made of jute fabric filled with earth and pumice aggregate, stacked without mortar but fixed with strips of cut bamboo driven through the layers. The elements were laid in a U−shape, the top of the wall was fixed to a ring beam, see Fig. 9−2. In order to avoid rotting of the fabric, the wall was covered with 4 layers of thin lime paint, see Fig. 9−3. The roof structure, built of tree trunks, rests on posts separated from the wall.

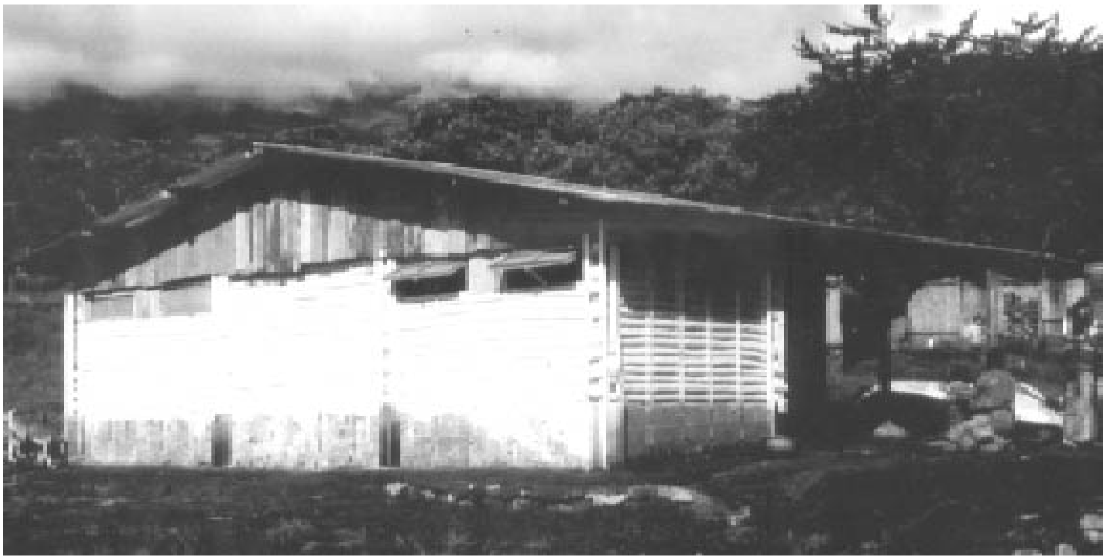
Within a research project concerning seismic−proof low−cost housing the FEB together with the University Francisco Marroquin and CEMAT, Guatemala, built a prototype house of 55 m^2 in Guatemala in 1978, see Fig. 9−7. In this case cotton hoses of 10 cm diameter were sewed, filled with earth and pumice (Fig. 9−4), dipped into lime milk (Fig. 9−5) and stacked between thin bamboo sticks (Fig. 9−6).

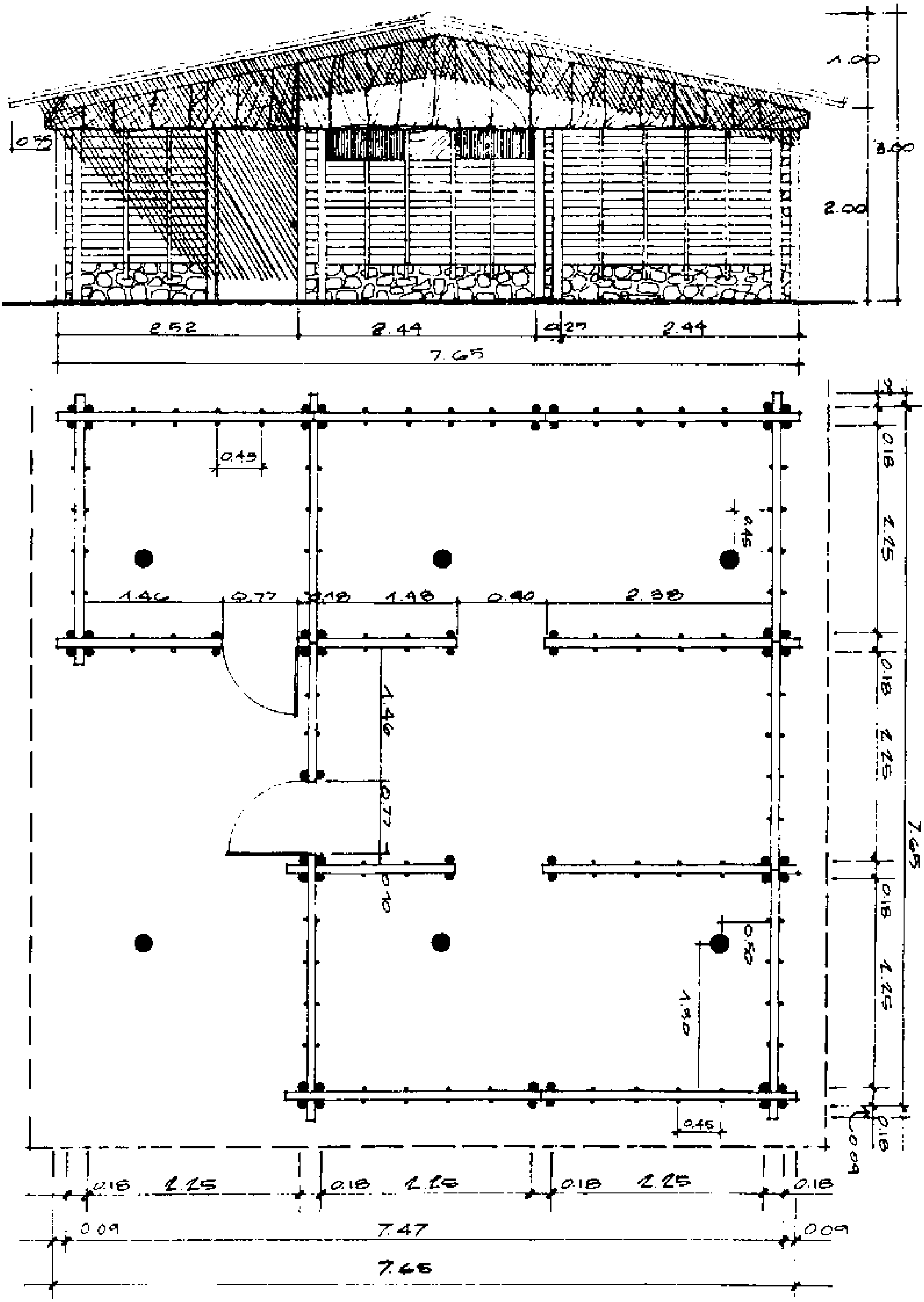


9−1 Low−cost housing prototype, University of Kassel, Germany 1978

9−2 and 9−3 Wall with filled textile hoses

9–4 to 9–6 Filling and stacking of textile elements


9−7 Earthquake resistant low−cost housing prototype, Guatemala 1978



1.00
3.00
2.00
0.55
2.52
2.44
0.27
2.44
7.65
0.45
1.46
0.77
0.18
1.48
0.40
2.38
1.46
0.77
0.10
0.50
1.30
0.45
0.18
1.25
0.18
1.25
0.18
1.25
0.18
7.65
0.09
0.18
1.25
0.18
1.15
0.18
1.25
0.18
0.09
7.47
0.09
7.65

9−8 Earthquake resistant low−cost housing prototype, Guatemala 1978

Four vertical posts every 2.15 m and thin bamboo rods of 2 to 4 cm diameter every 45 cm stabilized the wall. The surfaces were painted with a paint made of 1 bag of lime, 4 kg kitchen salt, 2 kg alum and 30 liters of water. In the prototype structure, shown in Fig. 9−1, another new textile system was tested, which is to be seen at the right side of the house. It consists of a prefabricated U−shaped wall of jute fabric, kept by wooden sticks pushed into the earth. The container ("bag") formed in this way was then filled with pumice and earth, see Fig. 9−9. The model of this system is shown in Fig. 9−10 and 9−11.

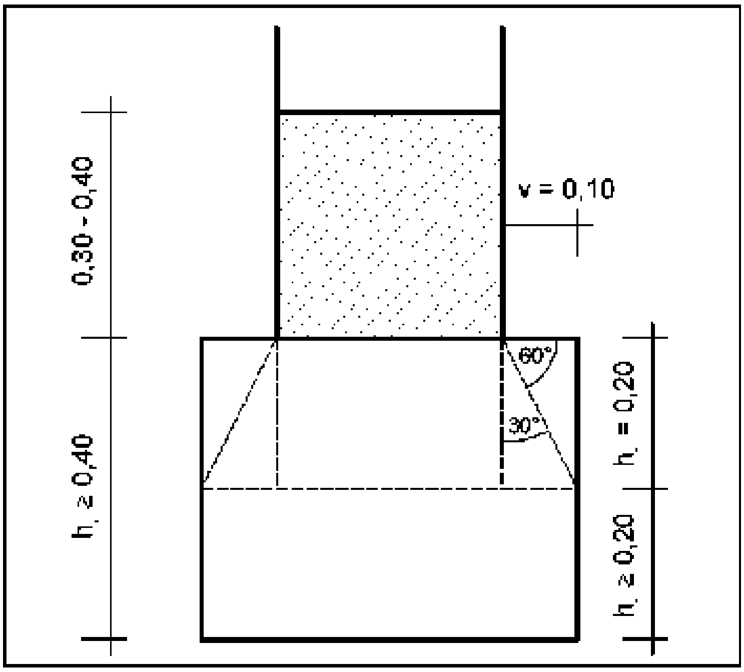
9−9 to 9−11 Textile wall elements filled with earth

10. Critical joints and elements

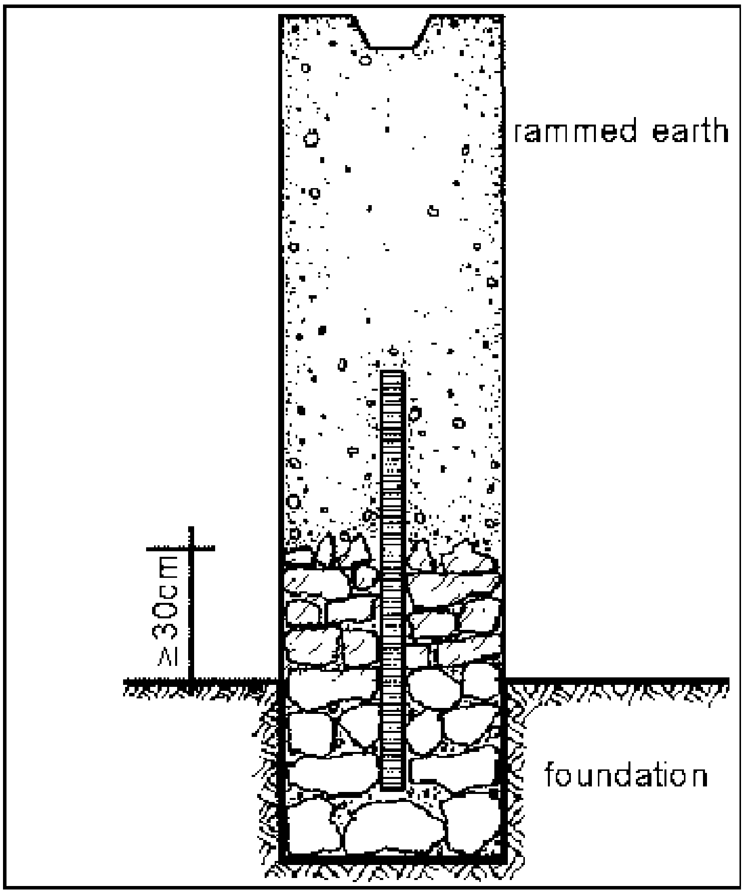
10.1 Joints between foundation, plinth and wall

For a wall 30 to 40 cm of thick the foundation should usually be 20 cm wider and 40 cm or more high, see Fig. 10−1, depending on the rigidity of the soil. With a 50 cm thick rammed earth wall the plinth and foundation can be of the same width. The plinth is usually built of rubble random stone or bricks, but can also be of concrete with large stone aggregates. As it shelters the wall against splashing rain water, the height should be at least 30 cm. The joints between foundation and plinth as well as between plinth and wall have to have a good bond in order to be able to transfer shear forces. They should be situated every 30 to 50 cm. The easiest solution is to integrate a vertical wooden rod and to create a rough plinth surface , see Fig. 10−2. In the case of adobe walls the mortar must have a very good adhesion and a high bending strength. Horizontal damp−proof courses will interrupt the necessary bond.

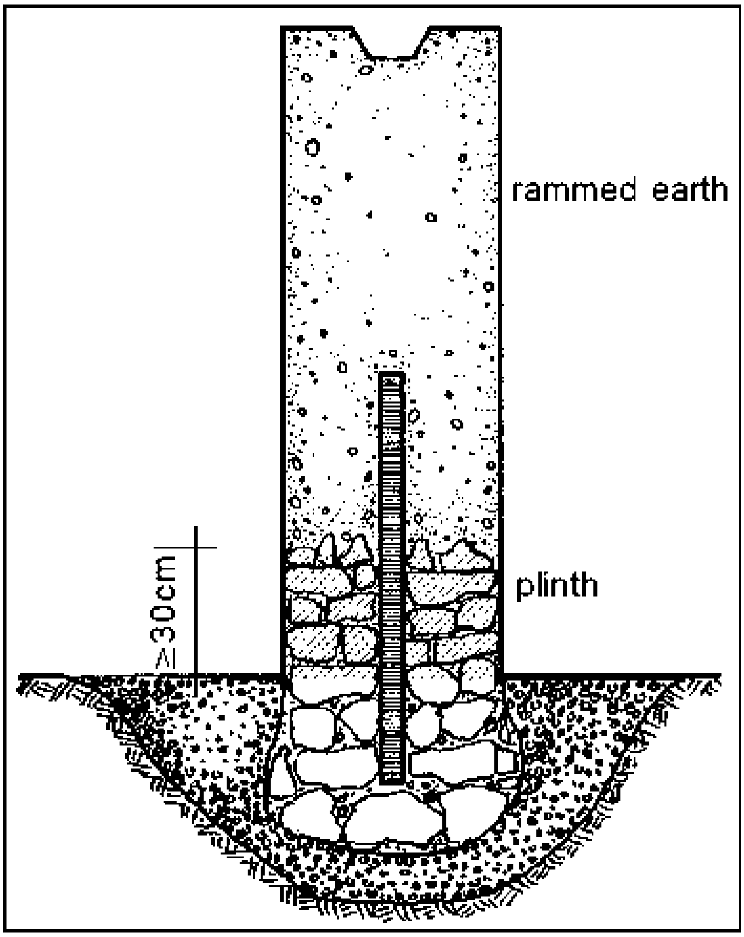
A proposal by the author, not yet tested, is a "floating" foundation created by a channel of round pebbles which reduce the kinetic energy of the horizontal shocks, see Fig. 10−3.



10−1 Foundation of external walls



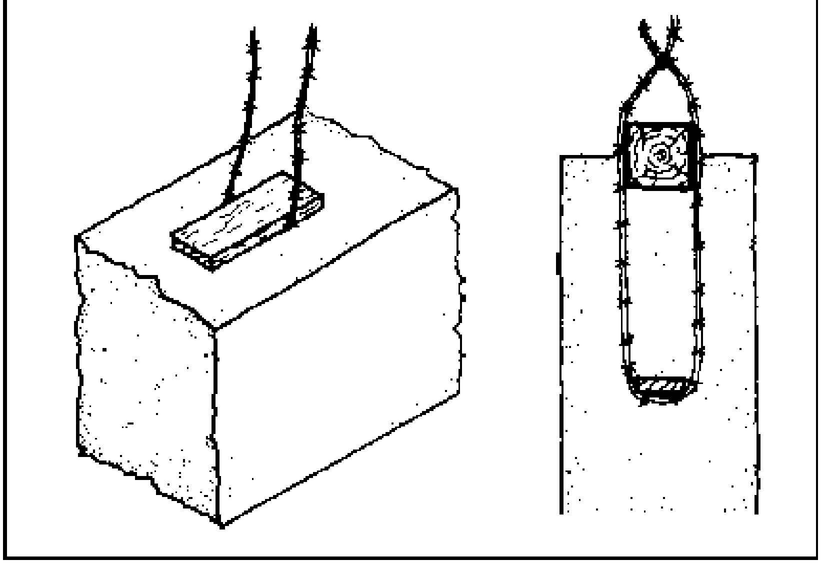
10−2

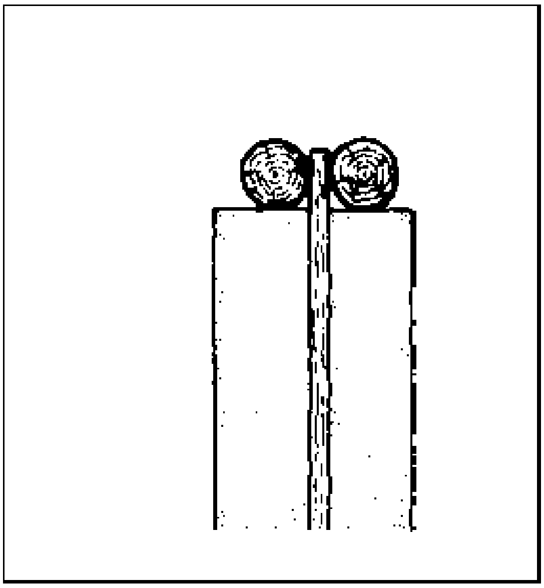


10−3 Floating foundation

10.2 Ring beams

Walls always have to be kept on top by a closed ring beam, which must be able to take bending loads when there are lateral forces against the wall. In order to prevent the walls from buckling and falling, the connection between wall and ring beam must be very strong. The ring beams can also act as a support for the roof structure. Fig. 10−4 shows one way of fixing a wooden ring beam to a rammed earth wall. A better solution is shown in Fig. 10−5 and 10−21, where a vertical interior reinforcement element of wood or bamboo is fixed to the foundation at the bottom and to a double ring beam at the top.

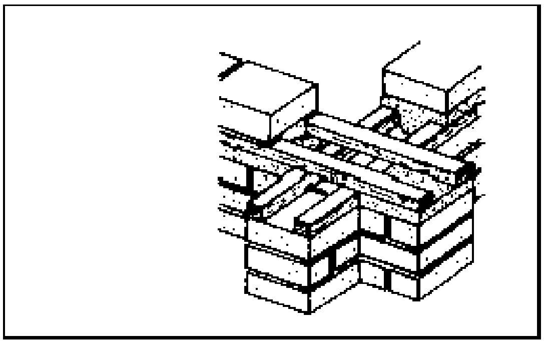

10−4 Fixing of ring beam



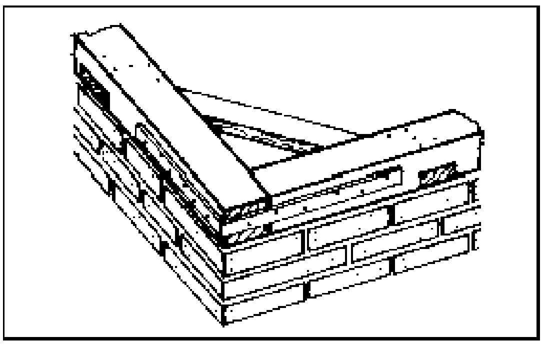
10–5 Fixing of ring beam

With adobe walls without vertical reinforcement elements it is not so easy to obtain a good bond between the masonry work and the ring beam. In the case of a reinforced concrete ring beam it is necessary to leave the last layer of adobes with open vertical joints so that the concrete will go into the gaps. In the case of adobe walls, if the ring beam is made from timber, as seen in Fig. 10–6, these elements must be covered by 2 cm of mortar with good adhesion values.

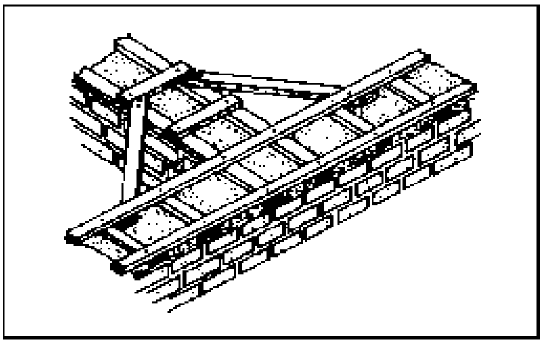
As corners of ring beams have to be able to transfer moments under seismic forces, they must be stiff. Figs. 10–6 to 10–8 and 10–12 show solutions for stiffening the corners for timber ring beams, while Figs. 10–9 to 10–11 show solutions for reinforced concrete ring beams.



10–6



10–7

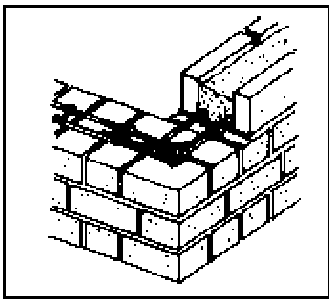


10–8

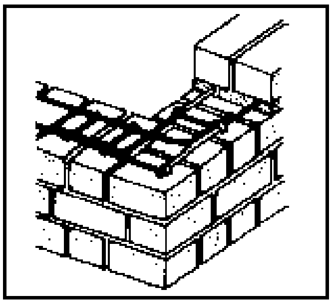
10.3 Ring beams which act as roof support

If the ring beams act as support for the roof structure, they have to be positioned centrally over the wall (Fig. 10–13). In the case of adobe walls the upper layer of adobe may break under seismic movement, therefore it is recommended that a top layer of burnt bricks be built for better stress distribution, see Fig. 10–14. In order to transfer the load uniformly from the roof beams to the wall, wedges of wood or concrete should be used. Also additional fixing is advisable, see Fig. 10–15.

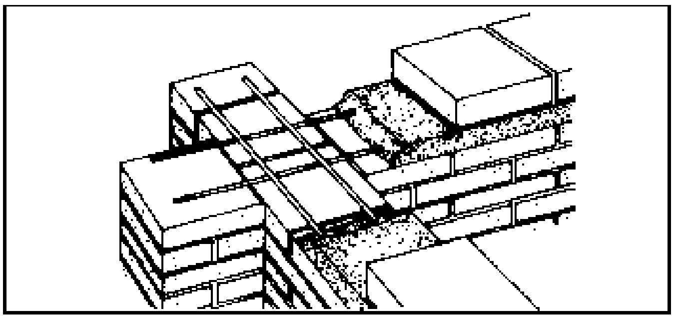
10–6 to 10–12 Solutions of stiffening of corners



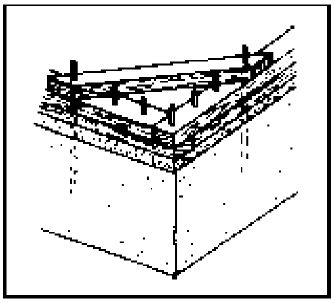
10–9



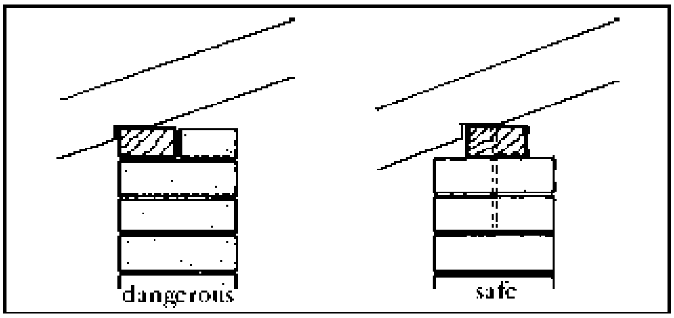
10–10



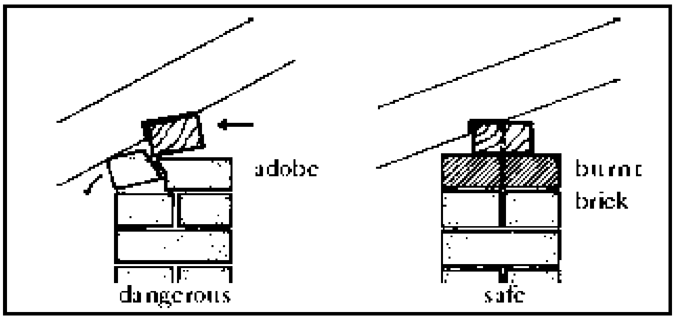
10–11



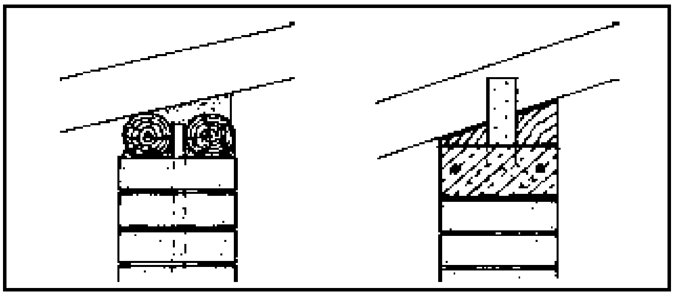
10–12



10–13



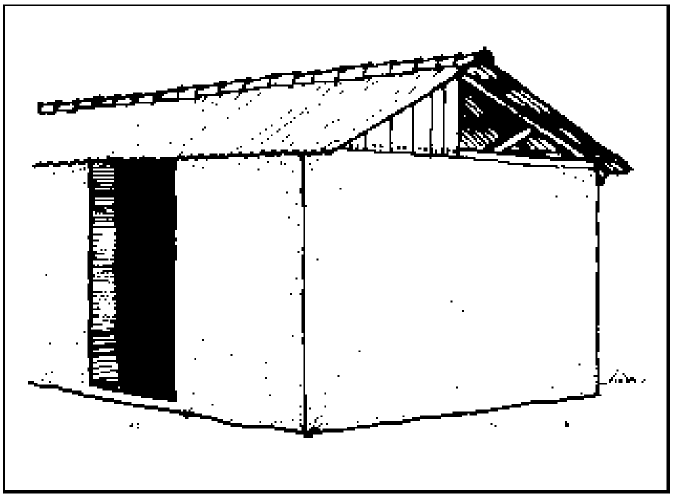
10–14



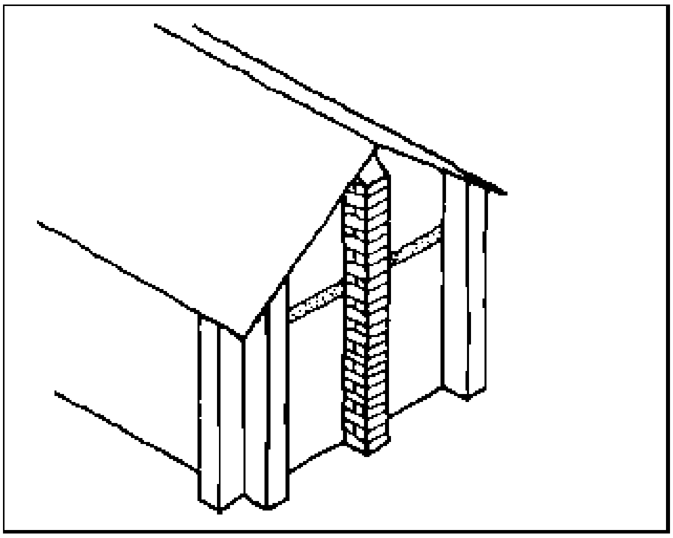
10–15

11. Gables

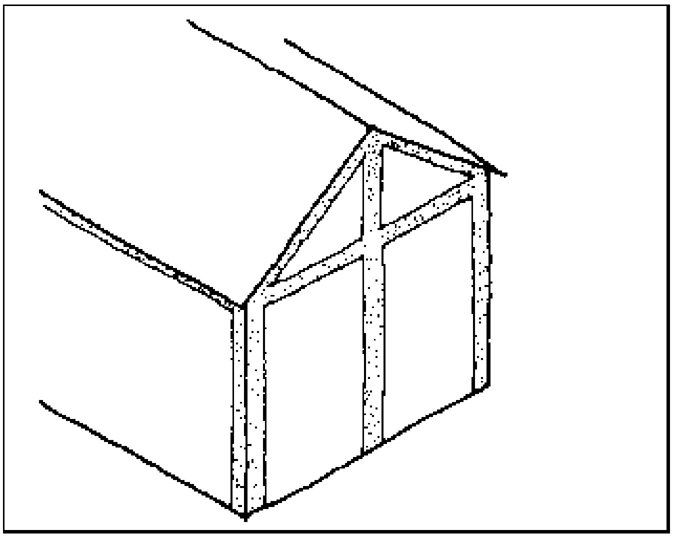
If gables are part of the wall, they are very weak against perpendicular forces. The best solution for avoiding this problem is to build a roof with four inclined planes (pyramidal shape), with which no gables appear. The second best solution is to build a light gable which is fixed only to the roof, as Fig. 11–1 shows. The third best solution is to build a gable wall and to stabilize it with a buttress, see Fig. 11–2. If a concrete skeleton structure is used, which is the most expensive solution, the gable also has to be stabilized by reinforced concrete elements, as shown in Fig. 11–3.



11−1 Gable fixed roof



11−2 Stabilization by buttresses



11−3 Stabilization by reinforced concrete structure

12. Roofs

12.1 General

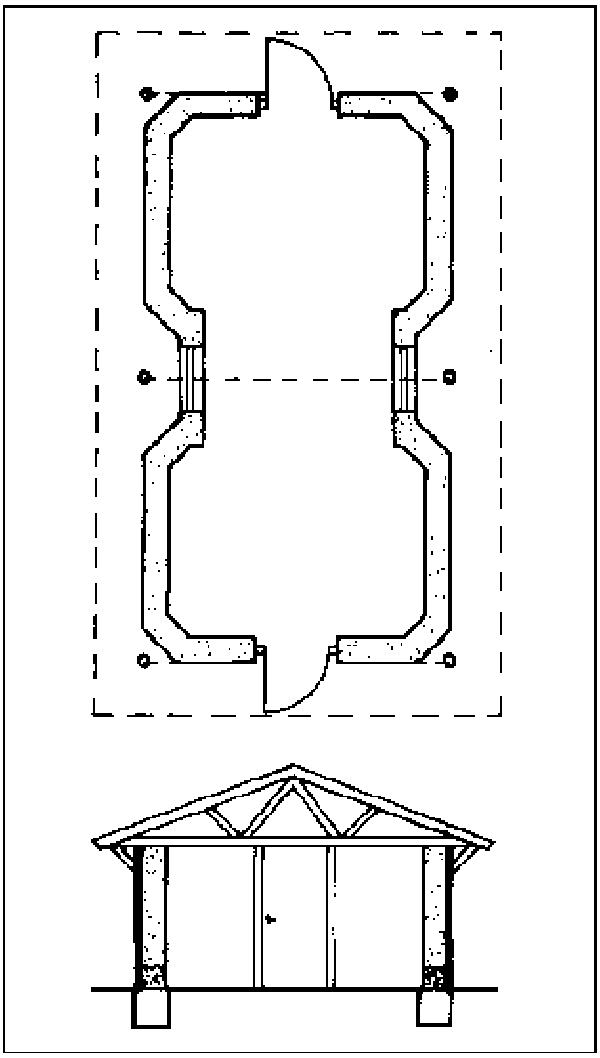
The roof should be built as light as possible. Roofs with tiles or stone plates are not recommended, as they are heavy and in case of an earthquake the tiles or plates might fall into the house.

For earthquake−resistant houses a pyramidal roof with 4 inclined planes, which rest on a horizontal ring beam, is the best solution. A simple roof of this kind is shown in Figs. 12−8 and 12−9. The most used solution is a roof with one ridge and two inclined surfaces, but in this case the beams on which the roof rests, must form a ring and cross the gable, which needs extra stabilization, see chapter 11, or must be fixed to the roof instead being a part of the wall, see Fig. 11−1.

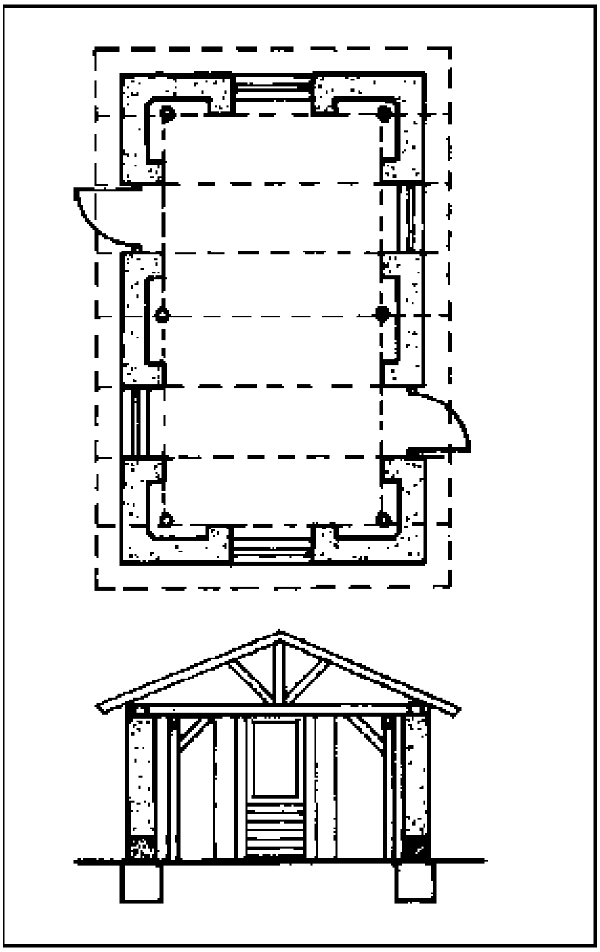
For smaller houses a roof with a single inclined plane is more economical, but in this case the beams on which the roof rests need to be interconnected, forming an inclined ring beam.

12.2 Separated roofs

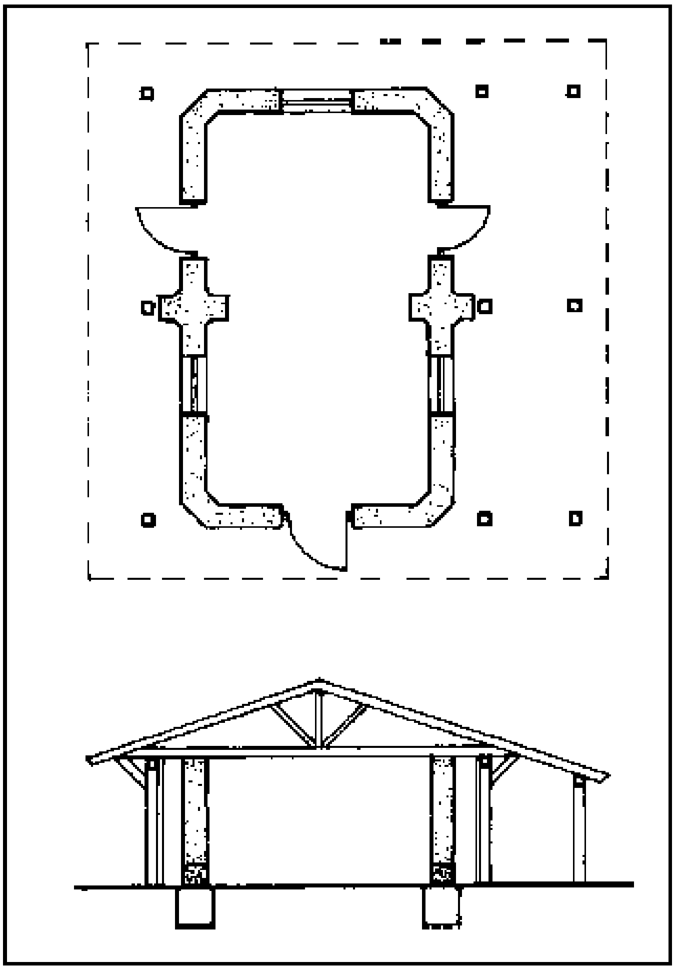
As the frequency of the movements of roofs and walls differs during seismic activities, due to their different moment and weight, the safest solution is to separate the roof from the wall and have it resting on columns which are positioned inside or outside the wall. Then the roof and wall systems can move independently of each other. Figs. 12−1 to 12−4 show different proposals of the author, utilizing this idea. It is necessary to fix the columns to the ground at the bottom and to the roof structure at the top in such a way that these connections are partially moment−stiff, but still allow some ductility. At the top of wooden columns short diagonals give best solution, see Figs. 12−1 to 12−9.



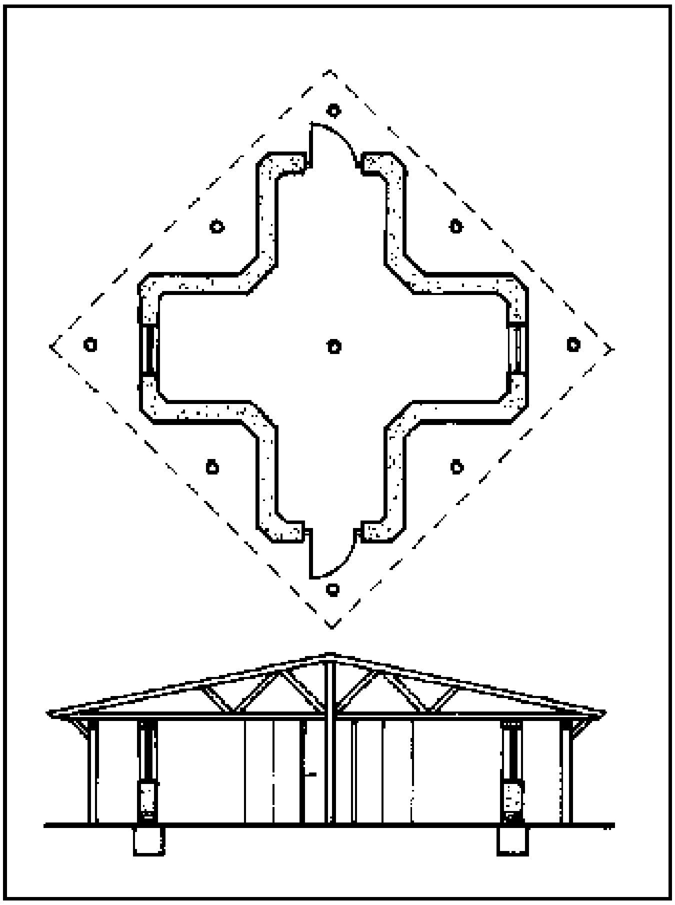
12−1



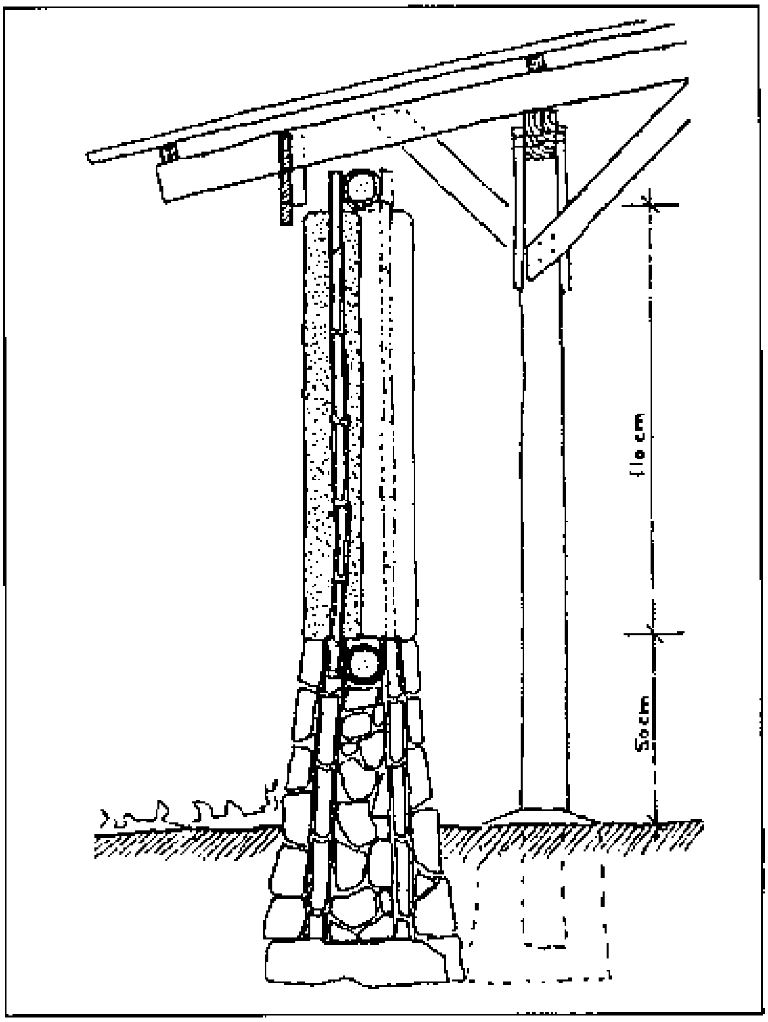
12–2



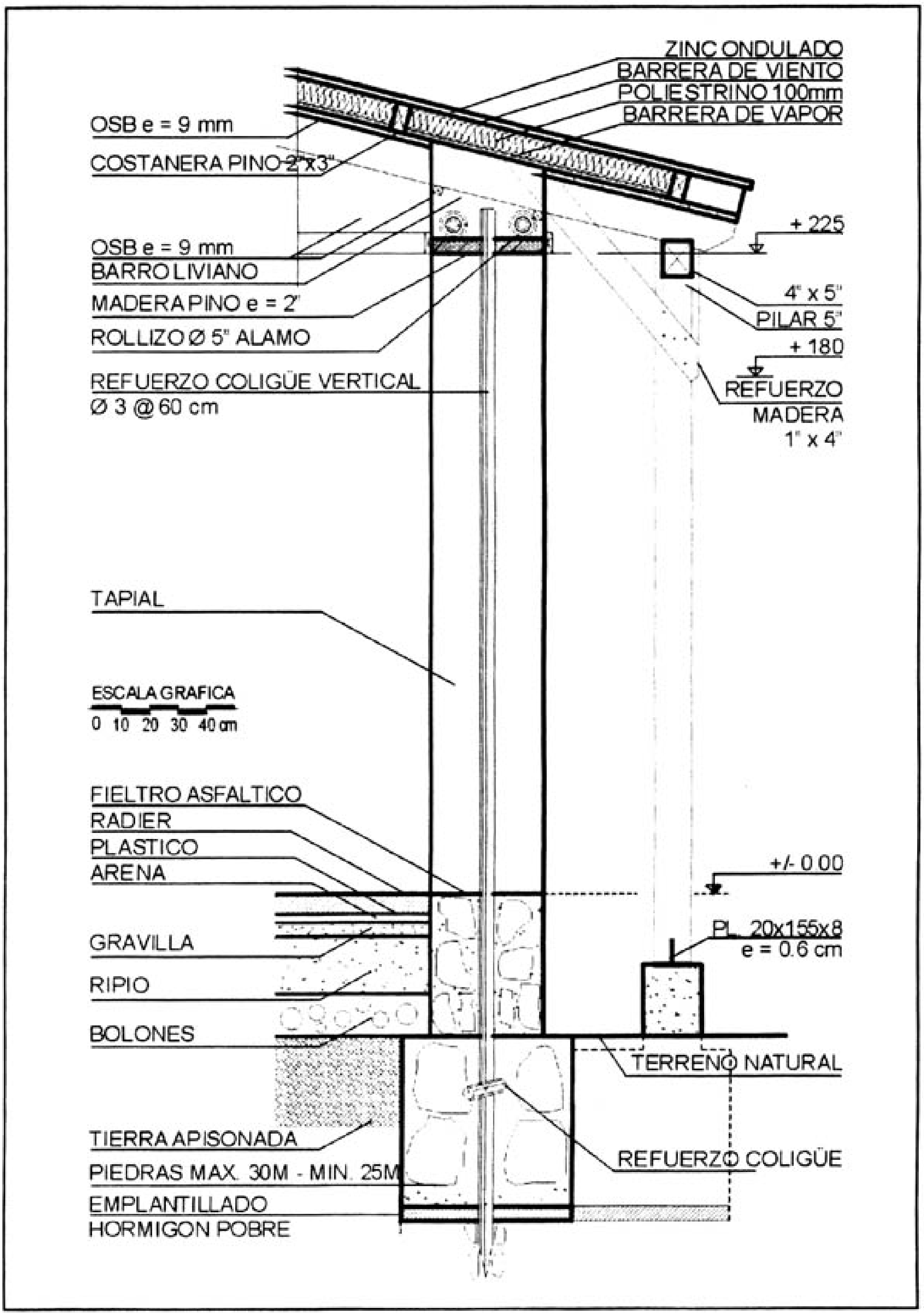
12–3



12–4



12–5 Reinforced rammed earth wall system Guatemala, 1978 (Minke 2001)



12–6 Reinforced rammed earth wall system Alhué, Chile 2001

12–7 to 12– 9 Proposals for plans with separated roof structure

12–7 to 12– 9 Earthquake resistant low-cost housing project Pujili, Ecuador 1989

Figs. 12−5 and 12−6 show solutions of projects which were described in chapter 6.4. In the first case the columns are positioned inside, in the second case outside the walls.

Figs. 12−7 to 12−9 show the construction of an earthquake−resistant low−cost housing project built in 1989 at Pujili, Ecuador (design: Gernot Minke and FUNHABIT, Quito). In this project the walls are built of two U−shaped rammed earth elements 40 cm thick, separated by a door or a window. The roof rests on four wooden columns, which stand outside the walls at the corners of the square. Though the columns reach into the foundation and are fixed to the ring beam by diagonals, the roof system shows sufficient ductility within an earthquake.

The roof was built of eucalyptus trunks, covered by caña brava (a kind of reed) and then plastered with a mixture of clayey soil with pumice, animal dung, sisal fibers and waste car oil. After drying it was painted with white paint.

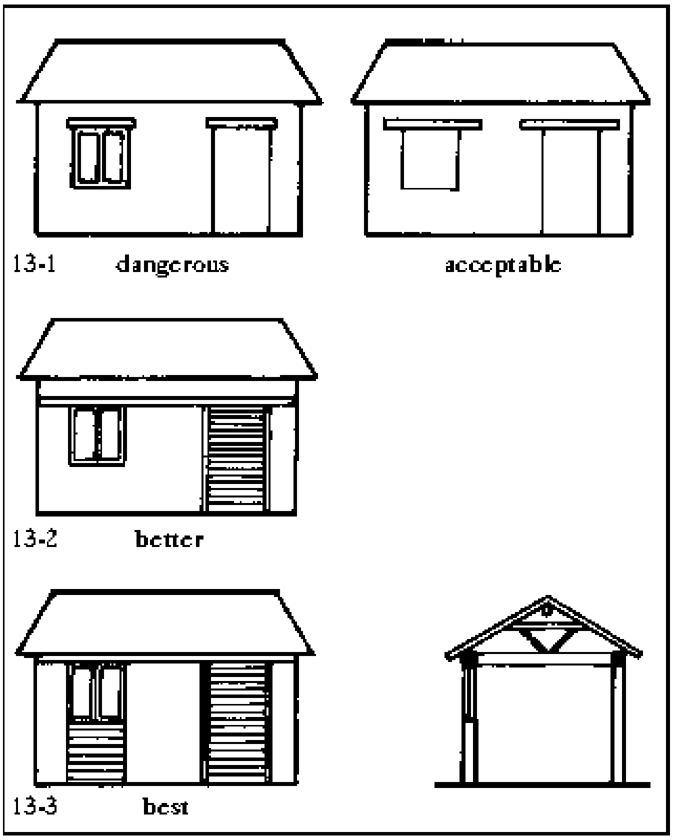
13. Openings for doors and windows

Openings within the walls destabilize the wall system. In an earthquake diagonal cracks often occur, starting at the window edges, see Figs. 4−1 and 4−2. Lintels have to penetrate into the wall for at least 40 cm in order to achieve a good bond, see Fig. 13−1. However, in this case the part above the lintel may be weak and come off in an earthquake, and therefore the best solution is to also use the lintel as a ring beam on which the roof structure rests. It is also recommended that the part below the window be built as a light flexible structure, for instance from wooden panels or wattle and daub. The following rules have to be taken into account, see Figs. 13−5 and 13−6:

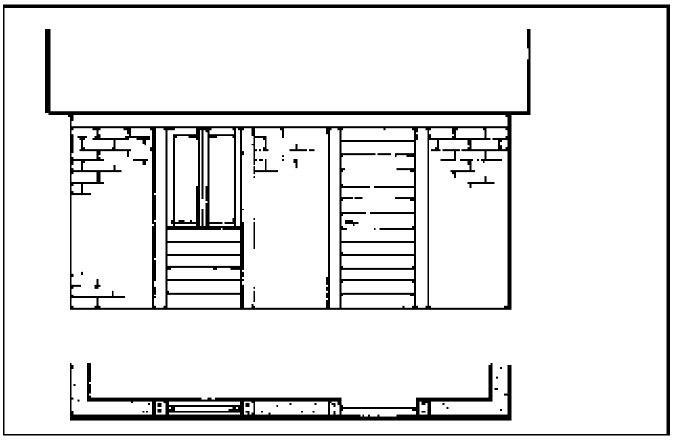
a) The length of the windows should not be more than 1.20 m and not more than 1/3 of the length of the wall.

b) The length of walls between openings must be at least 1/3 of their height and not less than 1 m.

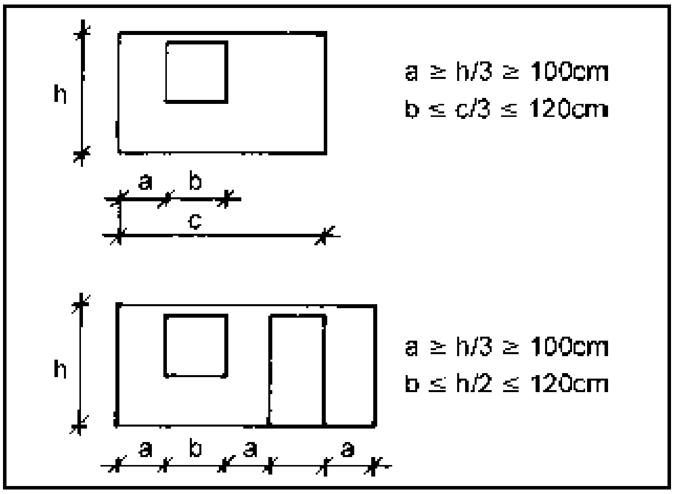
c) Doors must be opened towards the outside. Opposite the entrance door there should be a large window or another door, which acts as emergency exit, see Fig. 13−6.



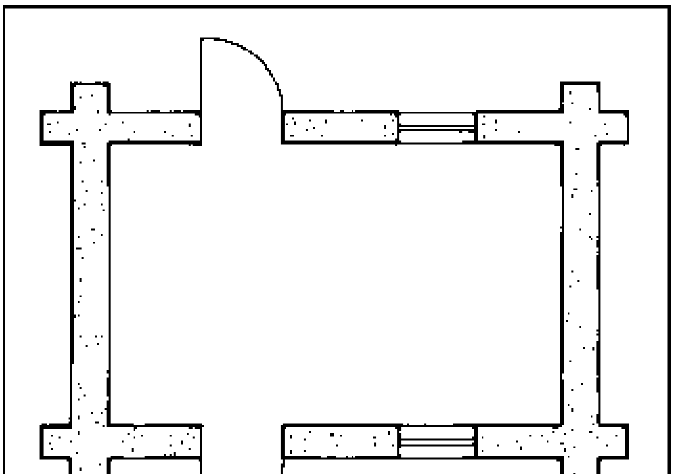
13−1 to 13−3



13–4 Stabilized openings



13–5 Recommendable dimensions of openings

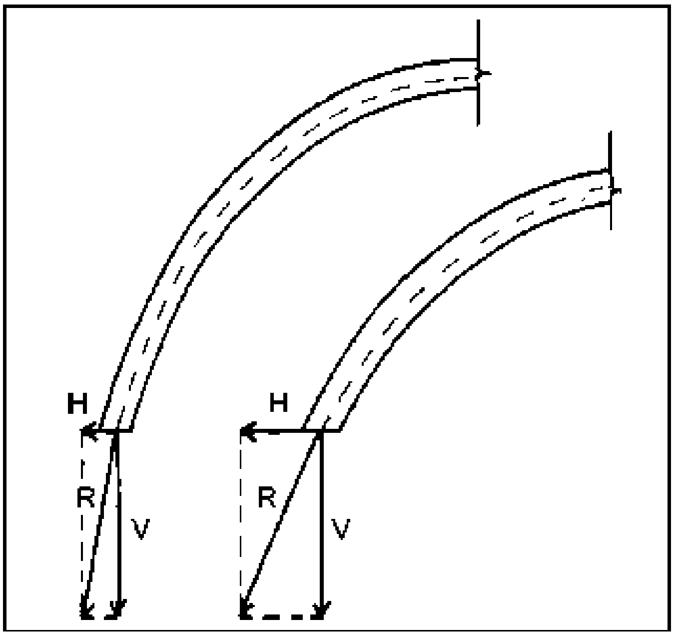


13–6 Recommendable positions of openings

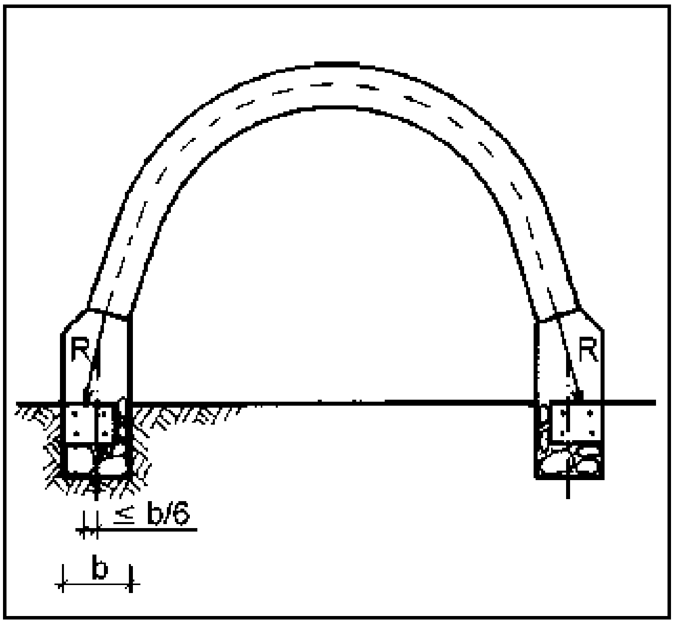
14. Domes

The problem with the structural design of domes is the stress transfer to the foundation. The inclined thrust force can be divided into a horizontal and a vertical component, see Fig. 14–1. The steeper the thrust (resultant), the smaller the horizontal component.

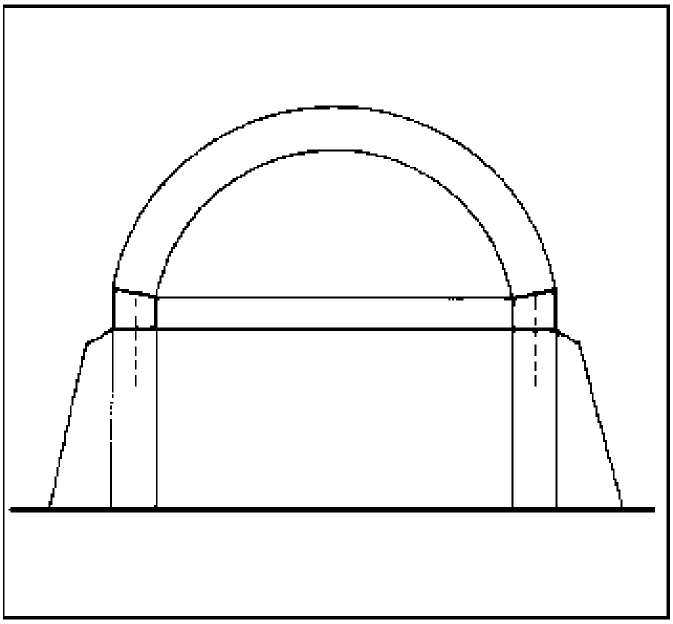
The support of a dome must be a circular horizontal ring of reinforced cement concrete, steel or possibly also timber, and it must be able to take the horizontal forces of the dome. The joint between dome and plinth or foundation must be inclined in order to resist the horizontal seismic movement, see Figs. 14–2 and 14–3. Because of the heavy weight of a dome, high ring beams and walls need to be stabilized by buttresses and the joint of ring beam and wall must be able to transfer large horizontal forces, see Fig. 14–3.



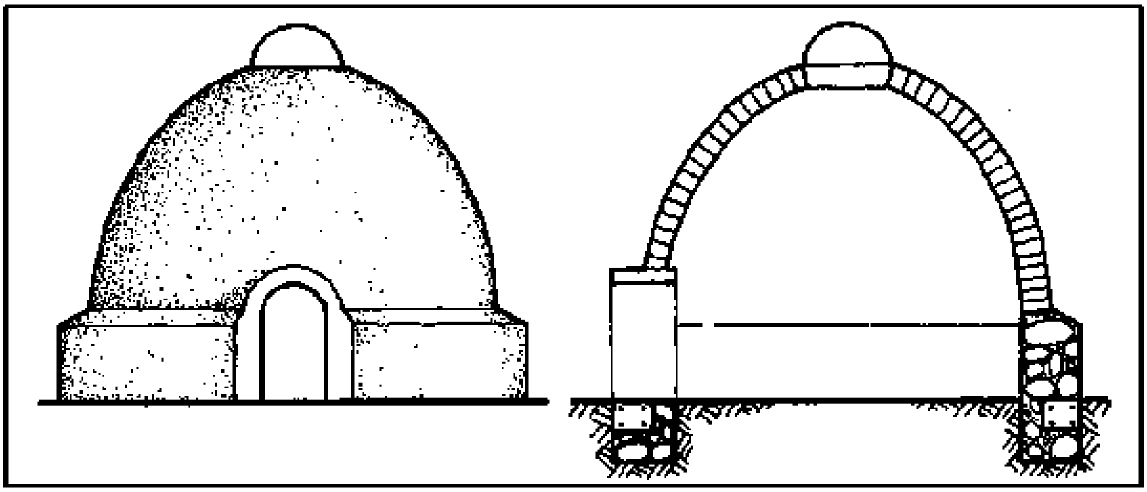
14–1 Resultant forces and their components (Minke 2000)



14–2 Allowable eccentricity



14–3 Ring beam stabilized by buttresses



14–4 Stabilization of dome entrance

If the dome rests directly on a low plinth, the structure is much more stable in an earthquake, see Fig. 14–2. In this case the foundation has to act as horizontal ring beam, and is usually built of reinforced cement concrete. It is important to check that the resultant force of the dome stays within the center third of the width of the plinth measured above the ring beam, i.e. the eccentricity must not be more than 1/6 of the base.

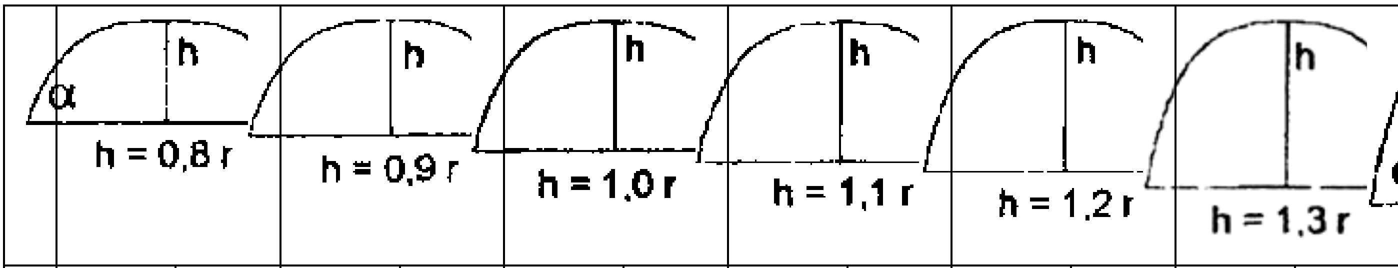
If the dome starts above a plinth, it must be taken into account that openings like doors and windows destabilize the dome structure. Therefore the tops of door and windows must be designed as vaults which penetrate the dome and are able to transfer the stresses from the dome to their sides, see Fig. 14–4.

An earthquake–resistant dome must have a certain section, which guarantees that all forces are transferred vertically to the foundation without creating tensile or compressive ring forces. The resultant forces must always be within the center of the dome wall, the eccentricity must be less than 1/6.

14–7 Dome coordinates for 7 different proportions (Minke 2000)

Nr	y	X	y	X	y	X	y	X	y	X	y	X
1	0,0000	1,0000	0,0000	1,0000	0,0000	1,0000	0,0000	1,0000	0,0000	1,0000	0,0000	1,0000
2	0,0452	0,9854	0,0454	0,9875	0,0479	0,9885	0,0470	0,9902	0,0422	0,9912	0,0494	0,9918
3	0,0973	0,9674	0,0982	0,9720	0,1013	0,9750	0,1007	0,9783	0,1016	0,9807	0,1036	0,9823
4	0,1489	0,9483	0,1508	0,9556	0,1544	0,9608	0,1543	0,9658	0,1555	0,9696	0,1578	0,9724

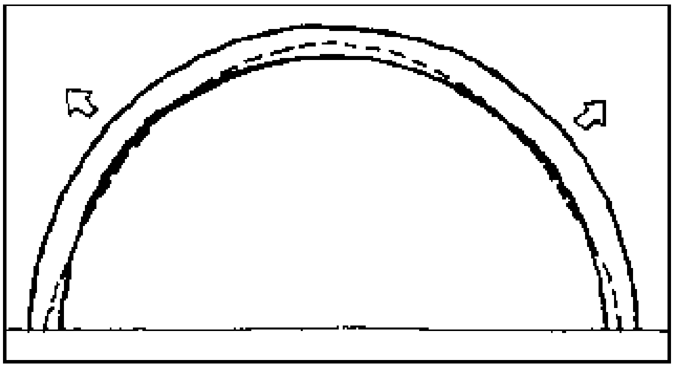
5	0,2001	0,9279	0,2030	0,9381	0,2073	0,9456	0,2077	0,9526	0,2093	0,9579	0,2118	0,9620	0,2098
6	0,2506	0,9061	0,2548	0,9195	0,2600	0,9295	0,2610	0,9386	0,2629	0,9456	0,2657	0,9511	0,2640
7	0,3005	0,8827	0,3061	0,8996	0,3123	0,9124	0,3139	0,9237	0,3164	0,9326	0,3195	0,9396	0,3180
8	0,3495	0,8575	0,3569	0,8782	0,3642	0,8940	0,3667	0,9079	0,3697	0,9188	0,3732	0,9274	0,3720
9	0,3974	0,8303	0,4069	0,8552	0,4156	0,8744	0,4191	0,8911	0,4227	0,9041	0,4267	0,9145	0,4258
10	0,4441	0,8011	0,4562	0,8305	0,4665	0,8533	0,4711	0,8730	0,4755	0,8885	0,4800	0,9008	0,4795
11	0,4893	0,7695	0,5043	0,8038	0,5167	0,8306	0,5226	0,8536	0,5280	0,8718	0,5331	0,8863	0,5331
12	0,5327	0,7355	0,5513	0,7749	0,5660	0,8060	0,5736	0,8328	0,5800	0,8540	0,5859	0,8708	0,5864
13	0,5738	0,6987	0,5967	0,7436	0,6143	0,7795	0,6239	0,8103	0,6316	0,8347	0,6384	0,8542	0,6396
14	0,6124	0,6592	0,6402	0,7097	0,6613	0,7507	0,6733	0,7860	0,6827	0,8140	0,6905	0,8364	0,6924
15	0,6479	0,6170	0,6815	0,6731	0,7067	0,7194	0,7217	0,7596	0,7330	0,7917	0,7422	0,8173	0,7450
16	0,6799	0,5721	0,7200	0,6337	0,7502	0,6855	0,7688	0,7309	0,7825	0,7674	0,7932	0,7966	0,7971
17	0,7081	0,5246	0,7554	0,5913	0,7913	0,6487	0,8143	0,6998	0,8309	0,7411	0,8436	0,7743	0,8488
18	0,7322	0,4750	0,7872	0,5462	0,8296	0,6090	0,8578	0,6658	0,8780	0,7124	0,8930	0,7500	0,8999
19	0,7522	0,4235	0,8149	0,4984	0,8646	0,5663	0,8988	0,6290	0,9234	0,6811	0,9414	0,7235	0,9503
20	0,7680	0,3707	0,8384	0,4485	0,8957	0,5207	0,9369	0,5891	0,9667	0,6470	0,9883	0,6947	0,9998
21	0,7801	0,3168	0,8576	0,3967	0,9227	0,4725	0,9716	0,5461	1,0076	0,6099	1,0336	0,6632	1,0482
22	0,7887	0,2624	0,8725	0,3436	0,9452	0,4221	1,0023	0,5002	1,0453	0,5696	1,0767	0,6287	1,0951
23	0,7944	0,2076	0,8836	0,2896	0,9633	0,3700	1,0286	0,4517	1,0795	0,5262	1,1172	0,5912	1,1403
24	0,7978	0,1526	0,8912	0,2350	0,9771	0,3165	1,0504	0,4009	1,1095	0,4799	1,1544	0,5505	1,1830
25	0,7994	0,0975	0,8961	0,1801	0,9870	0,2623	1,0675	0,3485	1,1350	0,4309	1,1879	0,5065	1,2236
26	0,8000	0,0425	0,8987	0,1251	0,9936	0,2075	1,0804	0,2948	1,1557	0,3798	1,2170	0,4596	1,2606
27	0,8000	0,0000	0,8998	0,0700	0,9974	0,1526	1,0894	0,2404	1,1719	0,3270	1,2415	0,4101	1,2933
28			0,9000	0,0000	0,9993	0,0975	1,0951	0,1856	1,1836	0,2731	1,2611	0,3585	1,3222
29					0,9999	0,0425	1,0983	0,1306	1,1916	0,2185	1,2761	0,3054	1,3459
30					1,0000	0,0000	1,0997	0,0755	1,1965	0,1636	1,2867	0,2513	1,3648
31							1,1000	0,0205	1,1990	0,1086	1,2936	0,1966	1,3789
32							1,1000	0,0000	1,1999	0,0535	1,2976	0,1416	1,3887
33									1,2000	0,0000	1,2995	0,0865	1,3949
34											1,3000	0,0315	1,3983
35											1,3000	0,0000	1,3997
36													1,4000
37													1,4000



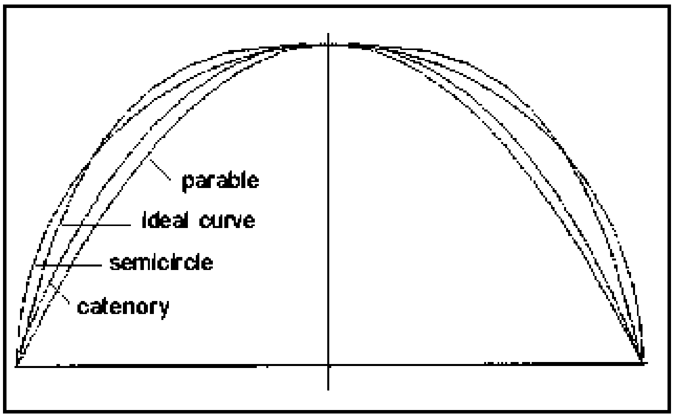
	h = 0,8 r		h = 0,9 r		h = 1,0 r		h = 1,1 r		h = 1,2 r		h = 1,3 r	
?	72,6	Grad	75,0	Grad	76,9	Grad	78,5	Grad	79,7	Grad	80,7	Grad
A	5,3374	r^2	5,7789	r^2	6,2195	r^2	6,6941	r^2	7,1685	r^2	7,6426	r^2
V	16,1064	r^3	18,2911	r^3	20,4262	r^3	22,6921	r^3	24,9307	r^3	27,1455	r^3

In a dome with a semicircular section the resultants of the forces act inside the center line, thus creating tensile ring forces which can easily lead to collapse, see Fig. 14–5. In Fig. 14–6 the ideal section line, which does not create ring forces, is shown in contrast to other usual curves. This curve was derived by a computer program. However, it can be found for 7 different proportions of height to radius, when using the coordinates listed in Fig. 14–7, where r is the radius and h the height of the dome – always measured to the center of the wall, **?** is the angle of inclination at the bottom, **A** the area and **V** the volume.

In order to construct such a structurally optimized dome without formwork, at the FEB a rotational guide was developed which is fixed to a vertical mast. At the end of the rotating arm an angle is fixed against which the mason lays the adobe or soil block. So each block can be placed in position exactly. Figs. 14–8 to 14–11 show the application of this construction technique for a dome of 8.80 m free span and 5.50 m height, built in La Paz, Bolivia, in 2000. The adobes for this dome were made by hand in a special mould with rounded edges, in order to provide good sound distribution within the dome. The acoustic behavior of the dome was further refined by deepening the vertical joints in order to achieve some sound absorption and by a slight cantilevering position, which avoids the sound focusing effect towards the center of the come.



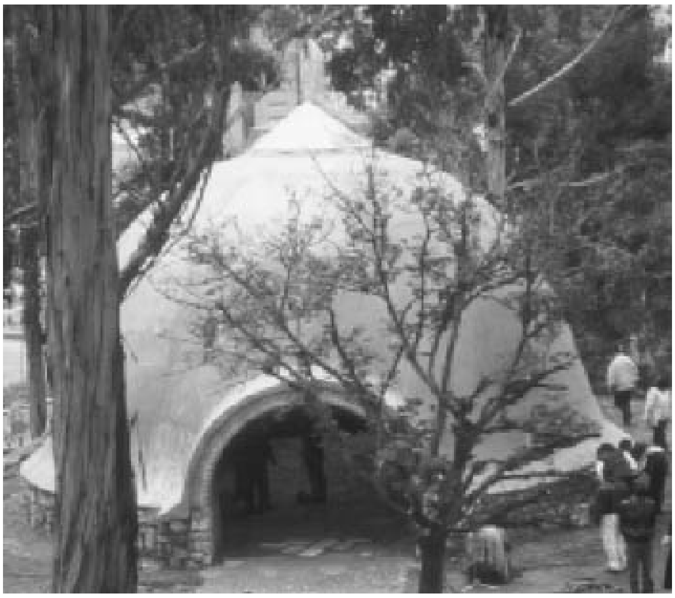
14–5 A semicircle is dangerous for dome section (Minke 2001)



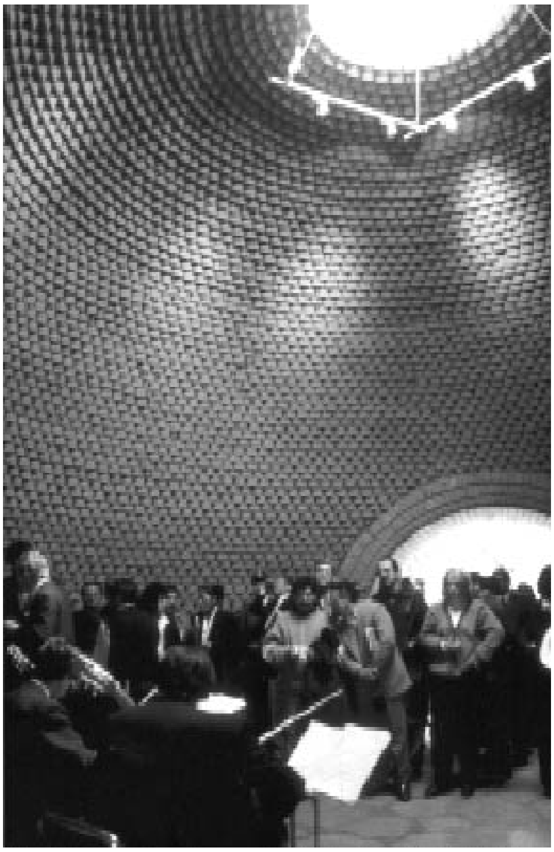
14–6 Ideal section curve in relation to other well known curves (Minke 2001)


14–8


14–9



14–10



14–11 to 14–11 Building of an adobe dome La Paz, Bolivia 2000

15. Vaults

In an earthquake vaults are less stable than domes, as described in chapter 14. It is advisable to have a square plan. If a rectangular plan is desired, buttresses or tensile elements connecting the beams are required, see Fig. 15–1. To create more stability, a vault should start directly above a low plinth instead of above a wall, see Fig. 15–2.

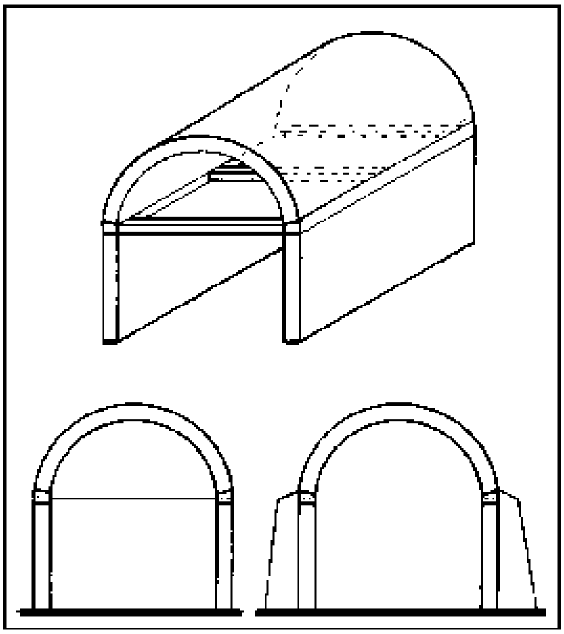
The vertical section of a vault should have the shape of an inverted catenary if it only has to transfer its own load. Then it only transfers forces in compression, see Fig. 15–3.

An important rule for the design of plinth and foundation is that the resultant force at the bottom of the vault should go through the inner third of the surface of the foundation. This means that the eccentricity should be less than 1/6, see Fig. 15−2. The foundation must have a reinforced concrete beam, which can also withstand the additional horizontal forces created by an earthquake.

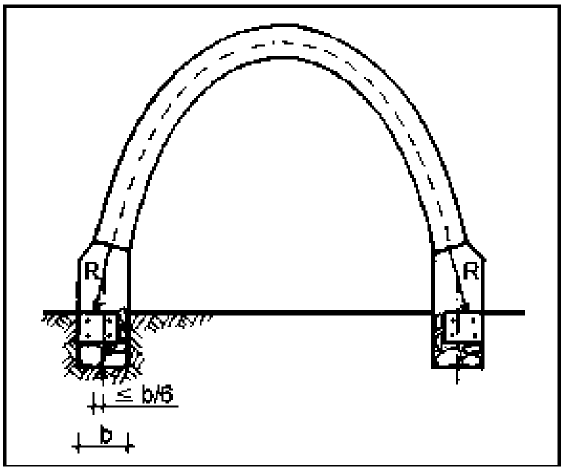
Fig. 15−4 shows a section of a building which was built in an earthquake−prone area in Bolivia. Its plinth has structurally dangerous proportions, as the resultant force from the vault creates a bending moment in the plinth and does not stay within the inner third of the wall, as necessary.

The facades of vaults should be stabilized like the gables described in chapter 11. However, the best solution is to build them light and flexible with "wattle and daub", mats covered with earth plaster, or with timber planks.

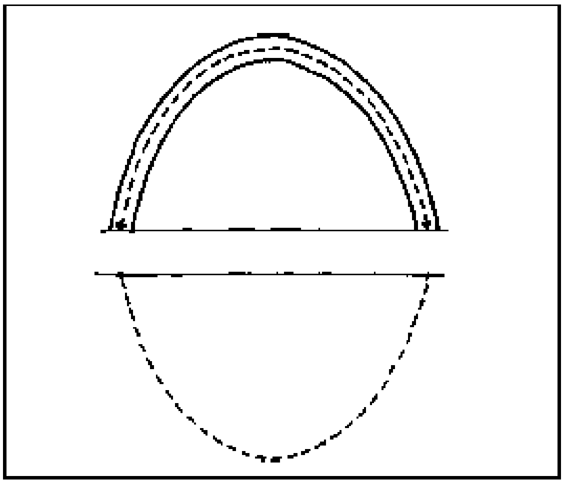
Fig. 15−5 shows a design of the author for an earthquake−resistant low−cost−housing project in the region of Gujarat, India.



15−1 Ring beams stabilized by tensors or buttresses



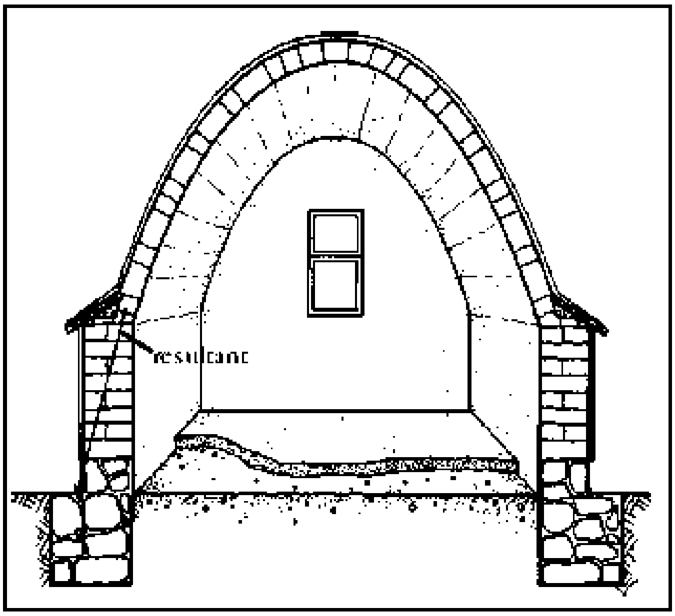
15−2 Permitted eccentricity



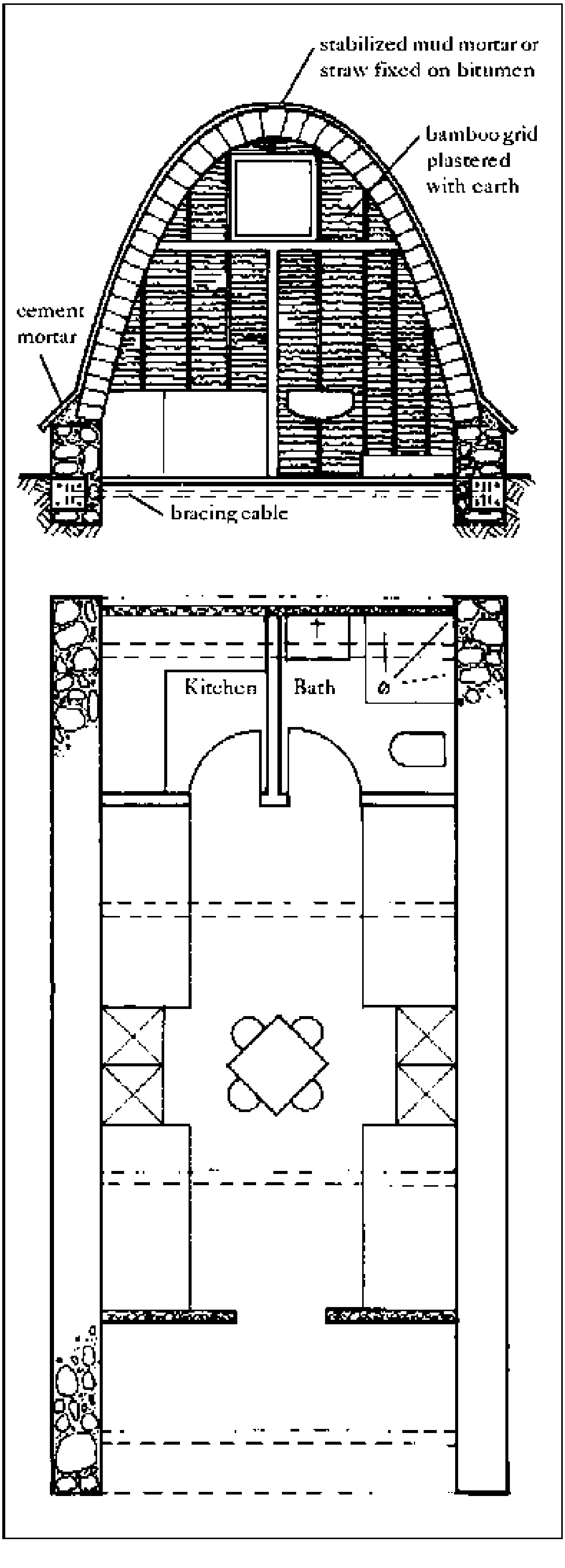
15–3 Inverted catenary as ideal section for vaults (Minke 2000)

A proposal for stabilizing adobe vaults by bamboo arches also guaranteeing a certain ductility was realized within a test structure built in 2001 at the University of Kassel, see Figs. 15–6 to 15–9. This was built with special U–shaped adobes which rest on an arch, built of three layers of split bamboo. The bamboo sections were kept in water for 3 days in order to be able to bend them. Then they were bent over sticks, which were pushed into the ground in a catenary line, see Fig. 15–7. In order to keep the arch in form, the three bamboo sections were wrapped together with galvanized steel wire every 50 cm. The arch was put into a vertical position and fixed to steel bars which stick out of the plinth. This connection must be able to take tensile forces within an earthquake. Above the adobe vault a membrane of PVC–coated polyester fabric is fixed and tightened to the plinth. This has two functions: firstly it gives shelter against rain and wind, and secondly it pretensions the arch and therefore increases its stability against movements created by the earthquake.

These movements may deform the vault to a certain extent, so that the adobe joints may open, but the vault will not collapse as it is held by the tensile prestressed membrane at the top and the compressive prestressed bamboo arch underneath. Thus the stability of this structure depends mainly on its ductility. However, it must be taken into account that if the pretension of the membrane is high, the optimal section of the vault is more like an ellipse.



15–4 Badly designed plinth with eccentric thrust line


stabilized mud mortar or
straw fixed on bitumen
bamboo grid
plastered
with earth
cement
mortar
bracing cable
Kitchen
Bath

15–5 Proposal for an earthqauke resistant vault structure for India

15–6 Production of special adobes

15–7 Construction of the arc with split bamboo

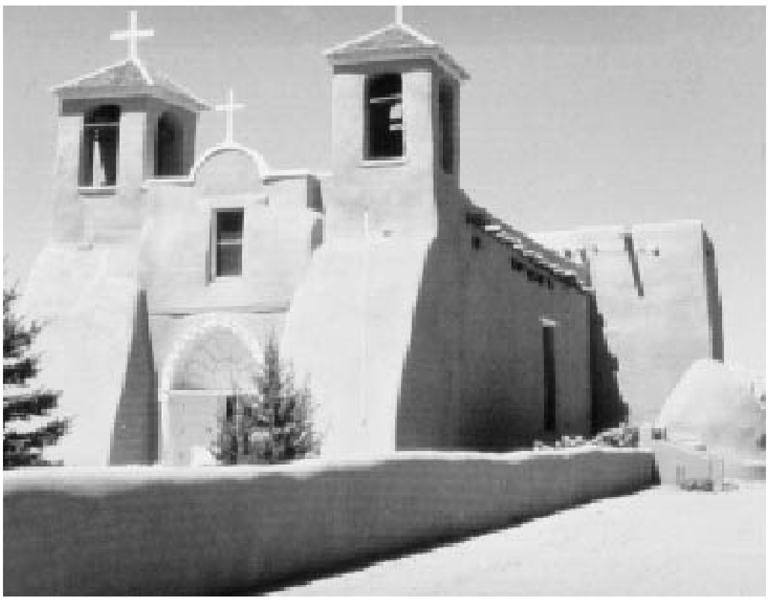
15–8 and 15–9 Earthquake resistant vault reinforced with bamboo FEB, Kassel, 2001

16. Plasters and paints

Adobe walls have to be plastered by mortars made of earth or lime, or by earth stabilized with cement, lime or bitumen. A pure cement plaster should never be used, as it is too brittle and tends to crack under thermal loads (through expansion and retraction) and under mechanical impacts. If water penetrates through these cracks, the earth underneath will expand creating more cracks, or even burst off.

The church at Ranchos de Taos, New Mexico, see Fig. 16−1, which was built in 1815 with adobe walls, was plastered with cement plaster during a restoration in 1967. Eleven years later the plaster had to be taken off, as rain water had penetrated through the many cracks and caused the destruction of many parts of the surface.

If an earth mortar is used for plastering, it is recommended that the surface be made waterproof by applying a paint of lime or lime−casein. Rammed earth walls do not need plastering. It is better to smoothe the surface with a trowel while it is still humid and then add two or three layers of thin lime or lime−casein paint. The first layer must have a high water content, so that it penetrates 2 or 3 mm deep into the wall.



16−1 Church San Francisco de Asís, Ranchos de Taos, EEUU

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The figures without sources quoted are from the author.

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Gernot Minke is architect and professor at Kassel University, Germany, where he heads the Forschungslabor für Experimentelles Bauen (FEB) (Building Research Laboratory). Since 1974 more than 30 research and development projects have been realized in the field of ecological building, low−cost−housing and especially building with earth.

In his private architectural office he has designed many private and public buildings, all of them having earth as a predominant building material. His buildings stand not only in Europe, but also in Central and South America and India. He is the author of several books, more than 200 articles, has been invited to more than 30 international conferences and was visiting professor in Mexico, Guatemala, Paraguay and Venezuela.

Back cover

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Guidelines for Building Measures after Disasters and Conflicts

Table of Contents

Table of Contents

Guidelines for Building Measures after Disasters and Conflicts

Division 42
Governance and Democracy

Eschborn 2003

Deutsche Gesellschaft für
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PREFACE

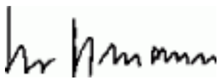
In the past years the global increase in severe natural disasters and the consequences of wars have led to an immense necessity of fostering the rehabilitation and reconstruction of living space especially in South−East Europe and Western Asia. The affected countries themselves can often only make little contributions to that. In the last decade alone, the German Federal Ministry for Economic Cooperation and Development (BMZ), above all, charged the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), German Technical Cooperation, with the execution of various redevelopment and reconstruction measures for the accommodation of refugees, displaced people and disaster victims.

Due to the special demands on the construction measures in the context of disasters and conflicts, the BMZ assigned the GTZ to develop guidelines for their conception as well as practical recommendations for their execution. Experience from the most different emergency situations have been specially compiled to elaborate the following Guidelines.

These Guidelines with the annexes present various practical references to the planning, procedures, and execution of reconstruction measures with special relevance to emergency situations after disasters and conflicts. It is addressed to external experts, to national and international organisations, project planners, consultants, project partners and project executing agencies, as well as to those employees of the GTZ who are in charge of the planning and execution of construction measures and their operation in emergency situations after disasters and conflicts.

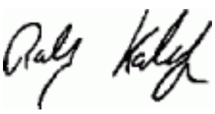
The concepts and proposals presented in the Guidelines are based on several years of experience of GTZ's technical personnel and aid organisations in the Balkan regions (Croatia, Bosnia and Herzegovina, Albania, Kosovo), in Turkey, Azerbaijan, Sri Lanka, India, Cambodia, as well as Central and Latin America. The Guidelines are to be seen from the point of view of a non−commercial general contractor (NGC) with a development−policy assignment who takes over the responsibility for the realisation of all measures and in doing so generally engages the private construction industry for the technical implementation.

Special thanks are extended to the authors Horst Valentin Kreutner, Birgit Kundermann and Kiran Mukerji, who elaborated these Guidelines. We hope that the Guidelines will meet your interest and look forward to an expert interchange and constructive criticism.



Bernd Hoffmann

Head of Division



Ralf Kaltofen

Emergency and
Refugee Aid

GTZ – a service enterprise for international cooperation

The Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, German Technical Cooperation, is a government−owned corporation with worldwide operations. Its development−policy mandate is to help improve the standard of living and prospects of people in partner countries all over the world, whilst stabilising the natural resource base on which life depends. GTZ is responsible for designing, planning and implementing programmes and projects in partner countries oriented by the German Government's development policy guidelines and objectives. The GTZ's main commissioning body is the German Government through the Federal Ministry for Economic Cooperation and Development (BMZ) and other ministries such as the Federal Foreign Office. Other clients of GTZ include the European Commission, UN organisations, the World Bank and regional development banks. Increasingly, foreign governments or institutions also directly commission GTZ services.

Technical Cooperation is playing a growing role in strengthening the capabilities of both people and organisations in partner countries. In achieving this, the institution is itself changing in the process: In the past, answers were found to clearly delineated problems, but today's intricate and complex issues call for more sophisticated approach. Sustaining improvements in people's living conditions in our partner countries in the long term crucially depends on the political, economic and social frameworks in place.

Where crises, conflicts or disasters create acute needs that threaten survival, GTZ provides development−oriented emergency aid (DEA). It has become increasingly apparent in recent years that the loss and damage can be averted by preventive measures, so approaches, instruments and measures have been developed to manage conflicts and prevent crises and disasters.

Refugee aid measures constitute an important activity area of DEA. Refugee programmes address people, who were forced to leave their homelands as victims of war or violent domestic conflicts, or on account of other disasters. The Guidelines presented here offer a general overview of building measures following disasters and conflicts, and summarise experiences and perceptions of GTZ.

1. Summary

Nowadays the consequences of natural disasters annually affect over 200 million people and the number of refugees and displaced persons amounts to over 20 million. This results in an immense necessity of reconstructing destroyed living space or providing temporary living space. The approach of development−oriented emergency aid (DEA) offers a framework within which a variety of questions that go beyond the actual technical construction measure can be discussed, especially those dealing with the working concepts of emergency aid, refugee aid, disaster precaution, as well as rehabilitation and reconstruction.

The development−policy demands on the construction of living space vary: in the case of war, refugees and displaced persons are to be accommodated temporarily as additional persons −without having knowledge about the duration of this accommodation. In the case of those returning after martial conflicts, quite often questions regarding settlement and property rights have to be clarified before a reconstruction of destroyed housing in favour of reintegrating refugees can take place. Considerable destruction triggered by natural disasters claims an extremely high number of homeless so that only part of the needy can be taken care of. Moreover, it is necessary to decrease the susceptibility to future disasters. People in need of dwelling space, possible beneficiaries, and potential future residents have to be selected on the basis of a thorough analysis, if disparities and potential conflicts are to be avoided by this measure. This becomes especially necessary when conflicts have led to flight and destruction.

The reconstruction of dwelling space in particular can contribute considerably to the stabilisation of the living situation of the affected population through more personal security and well−being and through re−establishing a productive everyday life. Supportive measures can strengthen the motivation for reconstruction and boost the local construction industry. Taking into consideration appropriate technical aspects of construction and settlement can decrease the susceptibility to future disasters. Thus, construction measures in the aftermath of disasters and conflicts constitute a fundamental contribution to redevelopment. Criteria such as significance, participation and self−help, poverty reduction, conformism, possible effects of conflicts, the reduction of vulnerability and, last but not least, sustainability have to be considered and weighed up in order to ensure the development−policy quality of the measures. Apart from that, main priority has to be given to the economic viability of the measures.

The concepts and suggestions presented are to be seen from the point of view of an organisation acting as a kind of a non−commercial general contractor (NGC) or an implementing consultant with a development−policy assignment. The NGC or implementing consultant "takes over" the responsibility for reaching the goals of all measures. He generally does not "undertake" the technical implementation himself, but instead employs the forces of the local and international construction industry. The financing of the projects in question is effected through technical cooperation (TC), financial cooperation (FC), development banks, the European Union (EU), the United Nations (UN), or other donors.

The methodological approach described in these Guidelines assumes that a donor manifests the intention of support on the basis of which a situation analysis or a rapid assessment is carried out by the NGC, and from this an offer or an implementation proposal is drawn up. It describes the individual steps starting with the placing of a commission via the implementation arrangement with the local project−executing organisation and all further planning measures required to carry out the commission up to the cooperation with companies

of the private construction industry. For the execution of construction measures contractor models and self−help models are presented in detail. They conclude with the handing over of the construction works and recommendations for the aftercare operations and documentation of the projects.

Various aspects to be considered are explained in short phrases, ranging from the defining of the commission and the proceedings during field work, via the analysis of the local construction industry, aspects regarding technical infrastructure and supplies that are connected to residential building, up to questions concerning the target groups.

The execution of construction measures in cooperation with the local and international construction industry (contractor models) comprises the presentation of the different concepts of rehabilitation and rededication of public buildings for the short−term accommodation of homeless people, as well as the rehabilitation of damaged or destroyed private houses. Moreover, the construction of new housing settlements is treated as an alternative in cases when rehabilitation models do not appear to be adequate for the solution of the emergency situation. All questions essential to the role and responsibility of the project management and those related to contract procedures and awarding of contracts are discussed.

When executing the construction measures by self−help, the target groups are given support in the form of consultancy, material and financial aid. Models to support individual family self−help as well as community self−help for the construction of accommodations and community facilities are discussed. The building yard model, which basically refers to material aid and assumes an execution of the construction measure by self−help, but which, depending on the situation, can in addition include further technical support, is also presented.

And finally, basic planning criteria of simple constructions are summarised, explaining the most important protection measures against natural hazards or measures to reduce the risk of destruction due to natural disasters.

These Guidelines concentrate on construction measures that require engineering expertise and management skills in the field of construction.

The annexes comprise a selection of exemplary forms for proceedings, the execution of tenders, samples of guarantee, and practical examples of planning and construction contracts, which of course have to be adapted to the respective situations.

Case studies of GTZ projects are inserted at different places to illustrate some of the models and procedures described, and also present some interesting cost figures.

Humanitarian aid or emergency aid in their narrow sense, which satisfy short−term protection needs against the effects of harsh weather by means of mobile material (e.g. tents), as well as the long−term consultancy of partner countries in the field of residential building construction and housing development, are not part of these Guidelines.

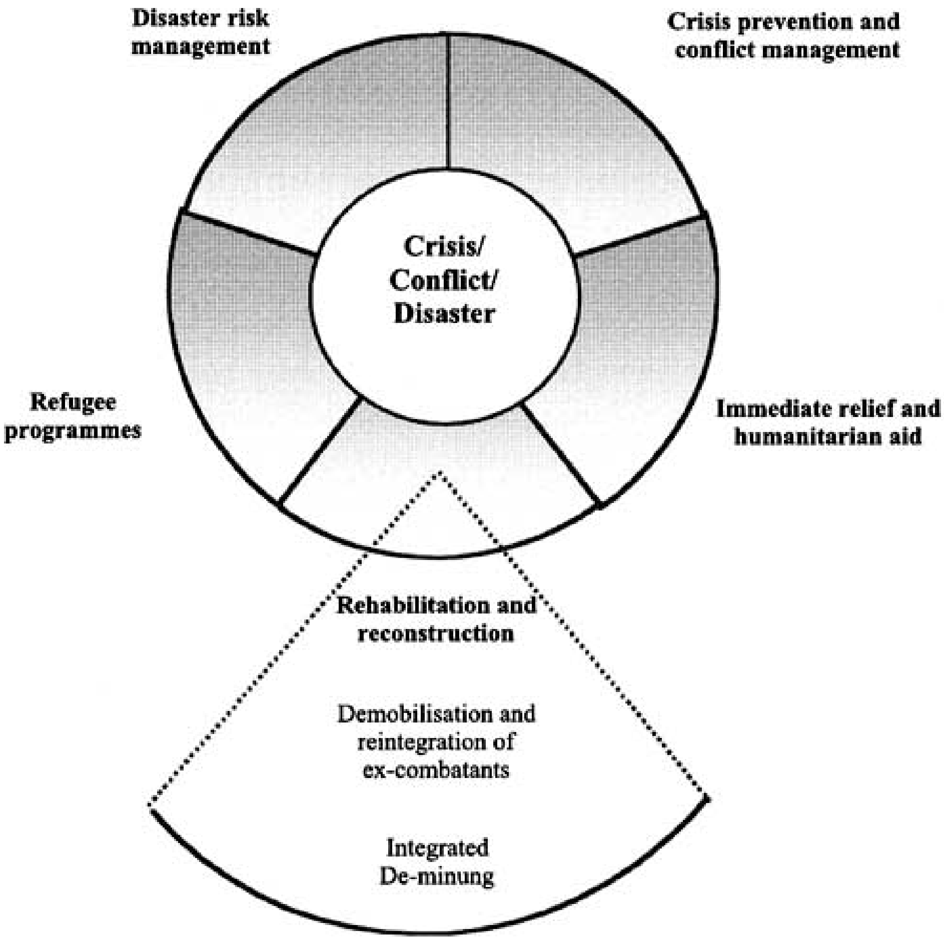
In the case of a GTZ−executed project, these Guidelines do not substitute the internal GTZ organisation directives, “Orientations and Rules” (O + R), which have to be observed in all events.

2. Building measures in development−oriented emergency aid (DEA)

2.1 Development−oriented emergency aid

The objective of development−oriented emergency aid (DEA) is to contribute to lessening people’s vulnerability and reducing the dangers to which they are exposed as well as to help alleviate the poverty caused by disasters and crises. This can be realised by preventing or coping with emergency situations on household, regional and international level. According to the development−policy conception of the BMZ, its aim is to ensure the transition from survival aid to reconstruction without interruption.

Development−oriented emergency aid comprises specific initiatives, measures, and reactions to emergency situations in crises, conflicts and disasters, as well as corresponding precautionary measures. They fit into the realm of disaster risk management, crisis prevention and conflict management, emergency aid and humanitarian aid, as well as in refugee programmes, rehabilitation and reconstruction. In certain cases, the "demobilisation and reintegration of ex–combatants" and "integrated de–mining" can also be part of DEA.



Activity areas of development–oriented emergency aid

In reality, borders between the fields of activity are fluent. After an emergency situation, it is DEA's concern to ensure the participation of the target group and to promote partner institutions already at an early stage and thus be structurally effective at all levels. DEA mostly comprises a package of measures which focus on a specific emergency situation and complement one another. Technical interventions such as the provision of infrastructure or living space are generally connected to consulting functions and a working towards a constructive socio–political development. (See also "Development–oriented emergency aid – GTZ's working principles" in the Bibliography).

2.2 Building measures in the context of development–oriented emergency aid

In emergency situations, the creation of living space contributes to the satisfaction of elementary basic needs. Living space increases the personal security of the people affected, creates privacy, and constitutes an important condition for the establishment of a productive everyday live. When executing building measures after disasters and conflicts the development orientation is reflected in the concentration on local actors (communities, construction companies, sector authorities), in the application of contractor and self–help models (see chapters 5.1 and 5.2) and in the overall capacity–building effects of the measures.

Building measures after disasters and conflicts usually take place within the framework of refugee programmes or reconstruction programmes. In certain cases they can also be considered as emergency aid measures. Disaster risk management with a focus on technical construction concepts is always part of building measures before or after disasters. Possible conflicts are taken into consideration when creating building measures with respect to reducing conflict potential.

Migration movements in the form of suddenly emerging massive surges of refugees or displaced people, but also in the form of creeping rural exodus out of disaster–induced impoverishment are often triggered by crises, conflicts and disasters. Within the framework of rehabilitation and reconstruction, the authorities responsible for the control of migration and new settlements can be given technical advice in connection with the aid measures as well as on issues that go beyond the scope of these Guidelines.

In the case of building measures, the projects are generally concluded with the buildings' acceptance when the actual utilisation starts. Therefore, the preconditions for sustainability have to be established by thorough planning and during implementation. Consultancy and further training of executing organisations and other institutions can be effected to ensure, for example, a better future administration of the dwellings and their connection to the local infrastructure, the living space and economic area. The integration of building measures into an overall concept or programme of DEA, which goes beyond their actual implementation, can guarantee those services even after the practical implementation of the building measures. Necessary accompanying measures can be integrated into this overall concept and aftercare operations following the completion of constructions can be realized more efficiently.

2.2.1 Refugee programmes

Refugee programmes (and correspondingly also programmes for displaced people in their own country) include measures of short−term refugee support in the host region as well as their repatriation and reintegration into their home region. Within projects concerned with the provision of living space for refugees in the host region on a short−term basis, temporary dwellings can be created for the target group. If, for this purpose, private houses or public buildings are rehabilitated in the host region, the building measure itself can also be considered as a long−term reconstruction measure in the host region. The planning and implementation of the building measure takes into consideration the needs of refugees as interim users and those of the host population as end users. In other cases, simple temporary accommodations in camps or collective shelters are established in locations outside the housing area of the host population. An informal after−usage often takes place, but is not subject of the planning and implementation of the building measure itself. Generally, the permanent settlement and integration of refugees in the host region is not part of development−oriented emergency aid. (See also "Development−oriented emergency aid −GTZ's working principles" in the Bibliography)

2.2.2 Rehabilitation and reconstruction

Within the framework of projects of repatriating and reintegrating refugees, permanent housing facilities have to be created and rehabilitated. Thus, technically speaking, they become part of the field of activity of rehabilitation and reconstruction, which aims at re−establishing or even improving the situation before the disaster or crisis. To reintegrate refugees into their home region can be a very complex and costly task, mostly combined with other measures, such as the promotion of economic and social reintegration measures (see also case study L − Sri Lanka). According to the specific context, the reintegration of ex−combatants within building measures can play a crucial role and thus also create better conditions for a peaceful coexistence in the future.

2.2.3 Disaster risk management

In the aftermath of disasters, residential building usually takes place in the form of rehabilitation and reconstruction in close relation to disaster risk management. No matter whether it is about selecting the location or applying the most appropriate construction methods, the reduction of vulnerability to disasters is the main focus, even in the case of repair works. The final utilisation by the population rendered homeless generally constitutes the planning base. In cases where there is a great urgency to provide shelter after a disaster within a very short time for a large group of people, temporary houses in the form of prefabricated structures with a limited life span can be considered (see case studies E −Western Turkey and G − Croatia in these Guidelines). In that case, depending on the aim of the building measure, it falls into the realm of emergency aid, since the urgency and the accommodation of large groups of people have been given priority over more expensive buildings with a long−term useful life. In all cases, building measures entail a massive intervention into the socio−economic environment. Thus, it is not only in the context of conflicts that the consideration of potential conflict effects is imperative (See also GTZ's "Disaster risk management − working concept" in the Bibliography).

2.2.4 Planning horizon and special conditions in emergency situations

Building measures after disasters and conflicts are carried out under considerable time pressure, especially at times when in temperate regions the winter season is about to begin. At the same time planning and implementation have to be carried out under particularly difficult conditions: due to the confusing situation information is often not available or unreliable. Especially during wars and immediately afterwards, planning becomes more difficult due to the unclear planning horizon, such as the duration of the crisis and the changing number of refugees and displaced people. After disasters and wars important road links are disconnected and the infrastructure facilities are partly destroyed. Administrations and executing authorities in the partner countries are overburdened and, after wars, partly staffed with inexperienced employees. The population is primarily concerned with ensuring their immediate survival. High economic losses or incomplete households limit the self−help potential of the people affected. Likewise the local construction industry might be directly hit by destruction.

2.3 Development policy criteria of implementation

The quick accommodation of the people rendered homeless is the objective of housing measures after disasters and conflicts. Generally the commission is accomplished when the building inspection takes place and at the same time the buildings are handed over to the beneficiaries. Development policy criteria of building measures basically refer to the long−term usage. However, the planning and implementation of the building measures include leeway for actions having a crucial influence on the project's development policy orientation via the selection of the implementation model and the implementation partner. In this respect, some of the following criteria tend to have contradicting effects in the practical pursuit. There is no patent remedy −they have to be evaluated in the planning phase according to the respective situation. The economic viability as a further criterion will be discussed in more detail in chapter 6.2.

2.3.1 Significance

The huge number of persons having become homeless due to expulsion and destruction of dwellings leads to a high demand for the re−establishment of living space. At the same time, the provision of shelter constitutes a comparably high individual support as long as it does not involve the utilisation of public buildings for temporary living purposes (see case study C − Bosnia and Herzegovina). In general, the largest part of the re−establishment of living space is carried out by the target groups themselves by self−help and with their own financial resources, partly supported by subsidies and special loan programmes. As a result of the high costs per user, projects of shelter provision generally only reach a small part of the needy − when considering the large number of affected people. The selection of the beneficiaries should therefore be carried out with great care and include criteria of need. In general this is done by local authorities that are sufficiently familiar with the area and the people. However, the financing agency of the aid measures or their appointed general contractor should ensure the definition of the selection criteria, as well as sporadically check and observe the local authority's needs assessment. The project's significance can be controlled by the selection of the models and concepts described in chapter 5.

When rehabilitating private houses, the benefit is also broadly extended to the host population, and in the case of public buildings in favour of the host communities. The self−help models of mutual aid and the building yard model (see case study L − Sri Lanka) can also have the same effect. However, in view of all previous experience, due to the immense back−up intensity, it is not to be generally assumed that self−help can reduce the total costs of the construction project.

The significance of residential building has to be evaluated not only with respect to the direct users but also to the indirect users, who apply the acquired building techniques in future construction projects. This happens, for instance, when the building technique constitutes a model for disaster−oriented building or when the skills transferred by way of training of construction workers consitute an important component.

2.3.2 Participation and self-help

Since building measures constitute a considerable intervention into the local structure, especially in the case of new settlements, all groups that are directly or indirectly involved, are required to participate in the planning and realisation of the measures. These especially include the following groups: the future (interim) users as direct target group, the possible ultimate users, the total population as being indirectly affected in the area, construction companies and the local economy, the local administration and the district authorities. Their active participation ensures the achievement of the project's intended goals: the quality of the process of identification of the beneficiaries and the cooperation with the local population reduces the risk of the buildings being misused after completion of the building measures. Therefore, even if the time pressure is high in most of the cases, the following opportunities should be taken into consideration:

- community participation, even if central project executing organisations and partner institutions assume responsibility;
- participation of organisations of the target groups or representatives (e.g. for refugees without adequate organisation);
- working towards the foundation of an empowered participation forum, where advantages and disadvantages can be considered for all groups and possibilities of reconciling interests can be discussed;
- working towards the involvement of the surrounding area's total population in benefiting from the measures, as well as in their implementation (provision of labour and commissions for local companies, even for smaller works);
- participation of direct beneficiaries in the designing of dwelling space;
- appropriate consideration of the future usage respectively the need of potential future beneficiaries.

Case study **A**

Reconstructions of houses after earthquake in El Salvador

Financing agency:	**Federal Republic of Germany represented by BMZ within development cooperation**
Financing volume:	**1,833,875 euros**
Period:	**2001–2002**

On 13 January 2001 an earthquake measuring 7.6 on the Richter scale hit the coast of El Salvador. On 13 February another earthquake measuring 6.6 on the Richter scale occurred, the epicentre of which was close to San Pedro Nonualco. The second quake, which was limited to just one area, only had a local but destructive impact. The damages covered extensive areas and affected more than 90% of the houses in the urban and rural areas, as well as roads, water supply systems, and the social infrastructure. This earthquake claimed a further 300 dead, approximately 3,000 partly severely injured, more than 32,000 destroyed houses and more than 150,000 homeless.

At the beginning of March 2001, BMZ decided to support the government of El Salvador in reconstruction and assigned the GTZ with the implementation of the project REVIVES (Reconstrucción de Viviendas en El Salvador/reconstruction of houses in El Salvador).

Indisputably, the aim is to reconstruct a significant number of houses. Besides and beyond this, building activities are enriched by complementary components and topics such as gender, training in the building sector, organisation, disaster risk management and improvement of the hygienic situation. In addition to training activities in concrete "learning by doing", accompanied by intensive consulting with permanent consideration of the highest possible transparency and participation of the most diverse groups, the methodology consists in decision−making. Therefore a complex network of different intervention levels and actors has been created for the implementation, connecting the different measures in the rural as well as the urban area, with the main actors being different groups of the local populations, the local authorities, as well as both of the administration units of the mayor's offices of San Pedro Nonualco and Santa María Ostuma.

The dual approach is peculiar to the project. On the one hand, earthquake−resistant houses adapted to the corresponding vulnerability to disasters were built in the rural areas. The institution responsible for property rights was contacted and the registration of sites in the national real estate register was supported. Thus the project succeeded in directly supporting families, as well as in making the rural population familiar with the institution and this mechanism. On the other hand, 29 houses with the same characteristics were reconstructed in the urban area, which, in addition, re−established the cultural identity by maintaining the style typical for the region, under the overall control of the municipal administration, the Vice Ministry of Housing, and the cultural council CONCULTURA. In the urban area, the planning of reconstruction resulted in the local development plan. Executing reconstruction with restoration character has so far been an unprecedented measure in El Salvador und has been greatly appreciated by both national institutions. At the same time, the population was sensitised to disaster risks with accompanying modules and their self−help capabilities strengthened, both practically and theoretically, paying main attention to women's participation in all matters. Personal contributions and mutual assistance in solidarity showed that the social cohesion can be fostered by joint aims, even if in some cases a lot of convincing had to be done first.

The project implementation lasted until the end of 2002. A total of 333 houses had been reconstructed in the rural area and 29 houses in the town centre (culture conservation). With the help of the reconstruction measures, a total of 1,763 victims of earthquakes could be accommodated in the rural area and 159 in urban locations. Applying a mixed calculation results in accommodation costs of 954 euros per person, including all accompanying measures, incidental expenses, and GTZ overheads.

The project continued the support initiated by emergency aid (supply of food and necessary consumer goods) and was complementarily extended by a TC reconstruction project that will last even longer (keywords: sequencing and sustainability).

Furthermore, self−help can be a major component of the rehabilitation and reconstruction of dwelling space. It can either take place within the "self−help models" described in these Guidelines incorporating the beneficiaries' participation as labour force in its narrow sense, or in the form of various personal contributions, even in the broader sense of "contractor models". Of importance in this respect are the craftsmanship and the target group's time capacities, which can be reduced due to the need to care for their families and secure their existence (agriculture and wage−earning). Criteria for deciding between contractor models and self−help models are described in chapter 5. Altogether, personal contributions arise from the participation in planning and implementation, monitoring, and several other services that are not directly and adequately remunerated. The measure itself and its success can be structurally effective as a contribution to the reconstruction or the development of the production capacities in the country: executing organisations, political decision−making bodies and, last but not least, the companies and people of the local construction industry make substantial contributions, even if local planners and construction companies, for example, are paid by donors' grants and take financial benefit from it. These earnings flow directly back into the trade cycle and foster the economic development of the concerned country.

2.3.3 Poverty reduction

Natural disasters such as earthquakes, floods, heavy storms and volcanic eruptions leading to the destruction of habitations in most cases affect the whole population of the disaster region. The poorer population groups, however, living in less solid housing, quite often on more susceptible land, are more severely harmed. In addition to that they seldom have the financial means necessary for the reconstruction of their housing. The objective is to counteract increasing poverty.

Thus, the concern of building measures must be to ensure the creation of dwelling space for the needy groups, whose own resources are insufficient for the reconstruction. It has to be taken into consideration that in many cases the needy groups are not in a position to offer a significant contribution in the form of manpower. The importance of a careful selection of the target groups was indicated under section 2.3.1, Significance. This can be determined by a reasonable choice of criteria of neediness, as for example the number of persons to be cared for per household, the number of household members that are able to work, the amount of household income, etc. The transparency of the selection process should be guaranteed by public announcement and the formation of the selection committee.

By selecting the model (see chapter 5), the involvement of the local enterprises or the national economy can be influenced, and consequently, this can have stimulating effects on the economy. Such impacts on the people's income in crisis regions are able to bridge poverty caused by the crisis, and by utilising the manpower of many – even unskilled – workers, they can have positive effects especially on the poorer population groups. Whereas the building of prefabricated houses mostly requires parts imported from abroad, most parts for the conventional local constructions can be obtained in the country. The questions of urgency and costs are, among others, the determinants for the choice of the construction method. Given the labour–law conditions, refugees or displaced persons (usually men) can apply as skilled or unskilled workers at the companies assigned with the provision of shelters. Opportunities arise especially in the case of large order volumes, when at least temporarily new employees are hired. A "cash for work" model in the field of self–help can also improve the households' economic power in addition to the self–help character. In all, the contribution and the allocation of the economic benefit to the individual groups should be assessed when selecting a model, in order to avoid an intensification of economic disparities.

2.3.4 Appropriateness

The appropriateness of the measures refers to socio–cultural factors, as well as to the construction standards, and the selection of material. Socio–cultural factors include the consideration of cultural, gender–specific, and religious characteristics, but also the accustomed form of housing estate, such as settlement with scattered buildings or agglomerations. The personal security of the beneficiaries has to be guaranteed and assessed on the basis of especially vulnerable groups (women, children, old people, minorities). Standards for spatial dimensions and equipment should in no case be higher than those of the resident population. It has to be distinguished between temporary shelter, guaranteeing a necessary minimum of hygiene, cooking facilities, and privacy and the final utilisation, possibly offering greater spatial dimensions. As far as possible, the designs should incorporate sufficient flexibility for the beneficiaries to be able to make changes within their dwelling spaces, add small extensions, and, for example, develop small vegetable gardens. In order to lay the foundations for an everyday life and the support of a productive coexistence, the construction of social buildings, such as kindergartens, schools, health care and community facilities, is indispensable. When rehabilitating existing living space, buildings of social infrastructure, such as schools and health care facilities, can also be rehabilitated or enlarged in order to be able to better cope with the new demands on the community. Appropriate planning and the involvement of the target groups' representatives considerably foster the ownership of the residents. Locally available resources should be considered in the use of construction material, in order to create regional economic effects as well as exemplary model solutions. Building measures are to be verified with regard to environmental concerns to avoid the over–exploitation of wood or other local resources. In the case of buildings that are to serve as models, an environmental impact assessment should be conducted to determine the risks of the future use of resources when spreading the technology.

2.3.5 Effects of conflicts

Due to the immense support of the target group, it is important to avoid or at least mitigate socio–economic disparities during the planning and implementation phase. Implementation models, which involve and support a significantly large number of different parties, either directly or indirectly, are more appropriate than those that only consider a specific target group of homeless people or the direct beneficiaries. In case employment and income opportunities arise for the whole population in the area, disparities and potential envy are limited.

Furthermore, the consideration of existing conflicts, especially in refugee programmes, has specific importance. In the light of conflicts that are still basically unresolved, the housing situation has an immense influence on the dynamics of the conflicts. Thoughts should be given as to how much physical distance is necessary to avoid further escalation as well as to possibilities of promoting a de–escalation, maybe even indirectly.

The employment of refugees can meet the local population's disapproval, lacking income possibilities themselves. To the disadvantage of the local population, the abundant supply of manpower can lead to a dumping of the wages typical for the area, particularly when refugees and displaced persons are already provided with their basic needs, such as food, free of charge. A limited operation of cash for work, however, can lead to a positive economic effect even with a shortage of formal work permits of the refugees. In the case of rehabilitation and reconstruction, the employment of formerly displaced persons and ex−combatants can have a stabilising effect on the conflict dynamics and help to contain everyday violence.

When rehabilitating and reconstructing, it is essential to clarify property questions before the construction measure, in order to limit, for example, potential disputes about utilisation, which tend to arise during the integration of formerly displaced persons. The infrastructure of the building measure should be adapted to the local standard. Additional infrastructure facilities for the host population can also be provided, if necessary. In order to promote reintegration, it is beneficial to plan integrated schools for the resident population, returnees, and possible new settlers, and to adapt the existing infrastructure accordingly. The forming of ghettos in the new settlements, which frequently have disintegrative consequences, should be avoided. Exchange and regulation forums, as well as groups for the joint observation of the effects, can also be created between representatives of the target groups, in the broader sense, and the beneficiaries of the dwelling space.

2.3.6 Reduction of vulnerability

Housing development after disasters is sustainable only if a reduction of the population's vulnerability to future disasters is achieved: within the framework of building measures basically by the correct choice of location and by disaster−oriented construction techniques.

Accordingly, building measures have to be assessed in terms of the extent to which the disaster risk can be reduced by the selection of the building site. A decision to establish new settlements on less risky terrain, however, entails the disadvantages that are commonly associated with new settlements. Besides deciding on the location, several technical details, some of which can be realised without significant additional expenses, can cut down the constructions' vulnerability to destruction by disasters. The planning criteria for simple buildings, mentioned in chapter 6, describe disaster−specific aspects. In addition to the realisation of planned building measures, the training of building enterprises, craftsmen and the population in the application of simple techniques for improved construction can be organised. Corresponding consultation of the responsible authorities can also contribute to an improvement of the strategies for disaster risk management. Provided the building measures are included in a package of measures of DEA, several possibilities arise to cross−link them with other precautionary measures.

2.3.7 Sustainability

The sustainability of building measures is assessed in terms of the objectives of satisfying the needs of the homeless and the quality of achieving those needs.

In general, sustainability is enhanced through the wide acceptance by all the parties involved and their integration in the project. In the event that the project executing organisation originates from the building sector, it is essential also to ensure the participation of the local authorities. Sustainability is also increased by the appropriate consideration of the needs of the interim and the end users. Building the dwellings for the end users represents the ideal prerequisite. In the case of refugee programmes, it is important to consider the final utilisation by the residential population in the host region after the return of the refugees.

Referring to the direct target group of beneficiaries, their elementary basic needs are satisfied and thus the conditions for development out of an emergency situation are improved. Already at an early stage, construction projects as well as back−up measures of DEA can provide organisational support the future beneficiaries. This facilitates personal contributions, neighbourly cooperation, and the functionality of the future administration. Back−up measures meeting requirements and follow−up assistance also serve to achieve improved sustainability. Customer satisfaction, however, can only be ascertained in retrospect. Since building measures after disasters and conflicts mostly do not include any promotion by executing organisations beyond the measure itself, structural effects on the institutions are generally not to be expected.

3. Methodological approach

The methodological procedure begins with

1. the donor/financing agency defining the intended support, thus

2. enabling an expert group of the NGC to perform a situation analysis and a rapid assessment, which, in accordance with the project executing organisation,

3. result in an offer by the NGC, incorporating a working or implementation proposal. After

4. the commissioning of the NGC by the financing agency

5. an implementation agreement has to be concluded between the NGC and the local project executing organisation, before

6. the implementation of the reconstruction measures can begin. Upon completion

7. the acceptance procedures, handing over and, if necessary, aftercare take place.

Documentation and knowledge management complement the measures with regard to the future evaluation of experiences.

3.1 Definition of the support of the donor or financing agency

The donor or financing agency verifies the eligibility for promotion of a supporting measure and defines his intended support. If necessary, he is advised by experts of the NGC. Normally he fixes a budget or a budget scope. The development–policy intentions of the donor, as well as matters that are deliberately excluded from support, have to be analysed. The same applies to the envisaged time frame. Rough notions of minimum and maximum standards should be compared. Questions concerning the possible desire for public appeal of the measures have to be clarified as early as possible. The donor/financing agency should check the contact addresses of institutions and persons, if any, that can provide support on location.

During the analysis and rapid assessment of the situation on location the individual appraiser, or the team, represents the interests of the potential donor/financing agency and follows any possible conditions it stipulates.

3.2 Analysis and rapid assessment

Questions regarding emergency aid are usually given priority in a rapid assessment. The second step for the building experts is to deal with questions of temporary shelter for disaster victims, refugees or displaced persons.

Within the framework of these Guidelines different solutions are described.

The question of the possible project type and the form of implementation already arises at the time of the situation analysis and the rapid assessment. It mainly depends on:

- the extent of damage and degree of destruction,
- the number of persons affected,
- the time frame in relation to the number of persons affected and the climate (winter/summer),
- the necessary/appropriate reconstruction technology,
- the availability of required human and material resources.

During the rapid assessment on location, the administrative structures of the project executing agency, if already nominated, must be investigated, as well as its expected performance capability. This decisively influences the conception of measures and the taking over of responsibility, as well as the possibilities of part financing of project components by the project executing agency.

The major steps of the needs analysis and rapid assessment are specified in the form of a checklist in section 4. There, the list mainly focuses on the building aspects of questions regarding the creation of emergency shelters or reconstruction.

3.3 Working and implementation proposal, offer

The NGC receives the commission on the basis of an offer incorporating an implementation proposal. The potential donor or financing agency should be informed of the situation by telephone immediately after completing the rapid assessment. It is advisable to send them the concept of a working or implementation proposal before elaborating the final offer in order to consider their comments and suggestions in the offer.

The offer itself should at least deal with the following aspects:

Brief summary of the project with short statements on problem analysis, project objective, planned results (achievements), target group, project executing organisation, cost figures, time schedule, assumptions and risks.

The terms of payment and special conditions of contract are to be agreed upon. The offer to the donor/financing agency should be made at the best possible cost estimates on the basis of the prime costs of the NGC. The imponderables in emergency aid and reconstruction measures are too great to be able to agree on a fixed price. If an upper limit is not to be exceeded under any circumstances, this upper limit can be agreed upon on the basis of a variable scope of works, which has to be adapted, if necessary, during project implementation, in agreement with the donor/financing agency. The same can be applied when sub−contracting construction works.

3.4 Commissioning

Depending on the financing agency the commissioning might go through a long administrative process. Nevertheless, in order to start the emergency measures on a secure basis as quickly as possible, it is recommended that a letter of intent is issued by the financing agency or, if commissioning is not yet possible due to formal reasons, a written confirmation to the NGC by the financing agency is necessary. This is advisable if, for example, an exchange of notes has to be executed beforehand. The statement should include an authorisation for commencing the measures, including the assurance that, in the unfavourable event of a project break−off, the expenses incurred up to that time will be reimbursed to the NGC. On such a basis the NGC will be in the position to invoice.

3.5 Implementation arrangement with the project executing agency or target groups

In cases of emergencies and disasters, administrations and political decision−making bodies in the affected countries are suddenly confronted with unexpected events. Total overburden, lack of experience and, as a result, inadequate coordination are the consequences. A great number of helpers come into the country from all around the world, in many cases even without experience, and want to start helping immediately.

It is essential to get acquainted with the potential local executing organisations or appointed political authorities and conclude written agreements with them, so that the affected administrations get an overview of the aid measures in the country. This is a minimum condition to achieve coordination, information, efficiency, an overview, a fair allocation of assistance and even more. An official, written agreement ensures legality and thus also a certain degree of protection of material and staff.

According to the political significance and the scope of the material aid measures, it may be desirable or necessary in bilateral aid measures to conclude a special exchange of notes. An exchange of notes constitutes the highest form of agreement between governments. The decision on that is taken at the ministerial level. The procedure is usually time−consuming. However, should there be a need for speedy implementation of the aid measures, there is the possibility of a pre−commissioning, as described under 3.4. The advantage of such an exchange of notes consists in the highest acceptance by all parties involved. Within its framework, exemption from import duty and taxes for material and personnel, competences and important partnership contributions can be regulated. It is common and time saving for emergency aid to use unilateral notes through the embassy, while exchange of notes within emergency aid projects is exceptional and makes sense only for very large projects.

Implementation agreements between the implementing organisation (here, for example, the NGC) and the local ministry in charge, having been appointed or especially created for emergency cases (e.g. Ministry of Construction, Ministry for Refugees), or downstream bodies, are common practice. In the case of bilateral aid, the German Embassy should be consulted when concluding the agreement. Essential contents of such an agreement could be, among others:

- nature and purpose of the aid measures,
- location of the measures,
- beneficiaries of the measures,
- specification of contributions to be made from both sides,
- amount of the financial contribution from the German side, or the donor/financing agency and, if so agreed, of the project executing organisation,
- tax exemptions for seconded experts,
- exemption from import duties on material and other taxes.

For regionally branched measures, in which the partner institutions delegate the responsibilities to provinces and communities, further implementation agreements with similar contents also have to be concluded with them, however, only with reference to the region in question.

3.6 Taking over, handing over, aftercare

The taking over and handing over procedures fulfil different functions in “contractor models” (section 5.1) and “self−help models” (section 5.2). While the procedures involving acceptance certificate, guarantee period, guarantee retention, etc., common in the construction industry worldwide, apply to “contractor models”, mostly followed by a media coverage and publicly appealing ceremonies of handing over to the partners or project executing agencies, the taking over and handing over in the case of self−help measures takes place successively after completion.

Newly established housing areas and buildings reconstructed to accommodate disaster victims require aftercare services. Already after the commencement of construction, questions concerning administration and management during the utilisation phase are to be discussed with the project executing organisation and personnel is to be recruited early. In the final stage and with the handing−over of buildings and installations, the latter is introduced to the technology of installations, such as electricity, gas, water, and sewage, and is put in charge of operation, maintenance, and guarantee claims after occupation of the buildings.

It is necessary to establish the technical means to be able to gradually recover the rental and operating costs from the beneficiaries by installing electricity, gas, and water meters during construction.

3.7. Documentation and evaluation

In the case of emergency aid measures, implemented in a relatively short period of time and under difficult and often chaotic conditions, documentation often comes off badly. However, it is exactly the experiences from such projects that are important to document, and thus make information quickly retrievable in a similar situation later on. Problems, that inevitably arise during such projects, can be better analysed the more information is available. Helpers in emergency situations are not always experienced experts, but very often dedicated people, who are confronted with such situations for the first time and depend on information from earlier relief operations. Documentation is also indispensable in view of knowledge management.

Although each disaster and emergency situation signifies extreme pain for each individual victim, press reports are often a lot more dramatic than the real situation, i.e. with regard to the scope of damage and the number of victims. When visiting the hardest hit places a photo documentation should be carried out, especially before the clearing up works. All further information from the investigations stated under section 3.2 “Analysis and rapid assessment” should be documented in written form. The planning process and important decisions should also be recorded.

Detailed stock–taking of the buildings and the situation on the spot constitute an important condition to match planning and demand. The planning is generally not done on the spot, so that not only written accounts but especially photos are indispensable. Before starting with actual rehabilitation measures, photos of the destroyed buildings should by no means be forgotten, in order to permit a comparison with the situation after their rehabilitation (before/after documentation).

Since many individual services and supplies by different partners are required for the progress of construction during implementation, a chronological documentation of the course of construction (time schedule) is imperative for the monitoring of the project. All decisions taken, especially the awarding of contracts, should be documented according to the existing conditions.

It goes without saying that all planning documents have to be kept for a period of approximately 15 years in the form of paper copies as well as on electronic media. Since plans are amended or modified according to the given circumstances during the implementation phase, “as–built plans” have to be prepared by the architects.

Aid funds are generally also tax money and are thus subject to certain usage guidelines which have to be observed strictly. Therefore, it is compulsory to document in detail the awarding of construction commissions, the contracts, and the costs, in order to be able to verify their correctness later. Further information can be found under 5.1.4 “Contracts and awarding procedures”.

With the help of today’s technical means it is easy to document all important phases of an aid project photographically. This is important to show situations before and afterwards, but also to document the gradual development during implementation, unforeseen events, and building components that will be concealed later on. These photos can be easily transmitted electronically, enabling experts in their home office, for instance, to participate in the solution of problems without having to undertake costly and time–consuming travels.

When filing the photos it is important to note the name of the place and the date on the file or on the back of the photographic prints. These details are especially helpful when producing information brochures, which should be a must for all important projects.

4. Needs analysis and rapid assessment on location

The following points of consideration and suggestions for the situation analysis and rapid assessment are restricted to investigations in the field of construction and technical infrastructure. In the concrete examples of the project planning and management, described in chapter 5, a series of further points relevant to the projects are cited, which, without claiming to be exhaustive, are to be observed as well. In retrospect, references are again made to the remarks under section 3.2 (Analysis and rapid assessment).

4.1 Before departure

Here again, reference is made to the remarks under section 3.1 (Definition of the support of the donor or financing agency). Additionally the following aspects should be considered:

Defining of commission:

- Clarifying the expected budget and possible modalities of the donor/financing agency;
- approaching the donor/financing agency about possible special instructions or reservations towards institutions/persons;
- agreeing with donor/financing agency on whether minutes of meeting can be signed, for example, by the project executing organisation;
- clarifying specifications/intentions concerning contents, target groups;
- ascertaining former and future cooperation in the partner country, as well as cross−connections, and aftercare.

Logistics:

- Ascertaining contact addresses on location (embassy, aid organisations, hotels, companies, planners/architects/engineers);
- considering relevant press information from the Internet or other sources and, if necessary, situation reports of leading organisations (UNHCR, International Red Cross) and others;
- clarifying communication links (e−mail, telephone, fax) with the relevant persons of the home office;
- deciding on interpreter; mobility in the country; international driver's licence;
- visa issues; valid passport; vaccination card; vaccinations; first−aid kit;
- personal financial provision;
- possibly taking out insurances.

4.2 Methodological recommendations for investigations on location

Collecting information:

- Procuring basic information, situation reports, etc. of leading organisations (UNHCR, International Red Cross), also on location, if available;
- investigating estimated numbers of refugees and persons rendered homeless, including indication of the sources;
- conducting conversations with relevant government representatives and, in particular, with the executing organisations of the aid measures;
- enabling information exchange with GOs or NGOs and e.g. UNHCR, that are present on location, thus providing an overview and possibly avoiding duplication of work;
- enquiring of the affected government about existing or planned aid programmes and responsibilities;
- enquiring about the government's budget scope, if possible;

• investigating aid measures of other donors in the building sector;

• substantiating and assessing information received by repeated enquiries of other parties involved;

• conducting general discussions about information and coordination with the German Embassy at the beginning of the investigations.

Project executing organisation:

• Clarifying core problems and aims, as well as priorities and persons in charge, as far as possible, in agreement with the project executing organisation;

• evaluating administration, potential performance capability of the project executing organisation, and other relevant government authorities concerned (building and planning authorities).

Participation and participants:

• Including the affected population in the investigations is desirable, but problematic. It makes sense when the people affected are represented by persons recognized and also accepted by the project executing organisation. Should this not be the case, the rapid assessment will have to be done without the inclusion of the victims. This will have to be made up for, if possible, at a later date, for example when planning and stipulating the standards of the building measures. It is not only the refugees and disaster victims that are affected, but also the local population, which is, for example, represented by a mayor.

• Investigating self–help potential, skills, initiatives of the affected population, the refugees, and the disaster victims.

Procedures and security:

• Assessing security risks (physical, economical, commercial) and clarifying logistic issues (transport possibilities);

• verifying possible cooperation opportunities with national military or foreign peace–keeping forces (formation of convoys for personal and material transports, escort, transport of relief supply, material transports);

• assessing general military presence.

4.3 Analysis of the local building industry

The investigations on location concerning building issues are conducted from the point of view of a non–commercial general contractor (NGC) or implementing consultant. The cooperation with the local building industry plays a decisive role. Should this fail to succeed, the aid measures will run the risk of being planned and carried out without sufficient adaptation to local possibilities and requirements and will thus be treated as third–party interests and alien, and persist as such. The costs will definitely rise with imported know–how, i.e. the recipient country will benefit less from the aid. The identification of appropriate companies to implement the measures on behalf of the NGC is of vital importance. The following investigation steps are recommended:

Information on the building sector in the partner country:

• Gaining access to professional chambers or associations of architects and engineers (if existing) via the project executing organisation, in order to obtain information (directories of members, addresses) and references to local partners;

• conducting the same queries at the ministry of construction or the local building authorities;

• enquiring at the ministry of construction about lists of local construction companies, if possible, itemised according to qualification and sub–divided into categories.

Assessment of local construction companies and planners:

• Compiling “short–lists” based on aforementioned information sources (chambers, associations, ministry of construction) for first interviews and with a view to future planning and construction tenders;

• conducting as many interviews as possible with the companies’ executive management to get an overview about its qualification and about the local building situation in the country;

• questioning the architects/engineers about the construction companies and vice versa, the construction companies about the architects/engineers;

• enquiring about references of architects’ and engineers’ offices and, if there is enough time, looking at projects and/or questioning former clients;

• conducting interviews with planners and construction companies in the companies’ offices, on the companies’ premises, if the time permits, in order to get an impression of the equipment and the “vitality” of the company.

Ensuring an appropriate procedure:

• Conducting similar enquiries with planners, building authorities, ministry of construction, and construction companies about the level of construction costs (price per m^2, price per m^3 for normal housing construction) and comparing them carefully;

• discussing the envisaged application of sample building contracts, in order to be able to analyse the general, and especially the international experience of the planners and construction companies in dealing with contracts;

• discussing the country’s common fee and remuneration practices with planners;

• questioning planners and construction companies on liability and guarantee issues;

• questioning planners and construction companies about the wage situation of architects and engineers, work potentials, material and production sources, and especially the bottlenecks;

• soliciting, if necessary in advance, relatively non–binding offers or partial offers for certain standard services for further consideration.

Logistics:

• Enquiring at construction companies and the ministry of construction about the transport situation in the country, i.e. capacities, transport costs per ton, costs per km, etc., prices for petrol and diesel fuel, situation of construction material and fuel supplies in general, and comparing the information with one another;

• enquiring at companies, project executing organisations and the ministry of construction about import procedures, import problems and time requirements; in doing so, questioning the situation of duty exemption for goods to be imported within the framework of aid measures (e.g. pre–fabricated houses, installation material);

• discussing the situation of the banks and questions concerning money transfer directly with the project executing organisations, companies, and banks.

4.4 Questions on infrastructure (land use planning and connections, energy, water supply)

Land use planning and connections: (see also sections 5.1.5.3 (1) and (2))

- Suitability of land in respect of reduction of vulnerability to disasters (see section 4.5)?
- Have surveys of land (cadastral maps) been carried out or who is in charge of them?
- Distance of site (for settlements) from borders, from war zones (recommended distance: minimum 50 km)?
- Road connections and public transportation?
- Connections to public institutions (schools, health care facilities, community facilities)?
- Which regional plans have to be considered?
- How can the maintenance of buildings and infrastructure be organised?
- Has storm water drainage been considered?
- Waste disposal – who carries the costs?

Energy supply: (see also section 5.1.5.3 (3))

- Which fuels are usually used in the country (gas, coal, electricity, wood)? What costs?
- What are the fuels used for (heating, cooking, lighting)?
- Availability (imported)?
- Site development costs, energy supply (distance)?
- Who takes care of the supply (project executing organisation, partial cost sharing)?
- What are the prevailing cooking practices?
- Size of household per kitchen stove? Kitchen stove with how many hot plates?
- How will the new dwellings be heated (fuel, types of heaters)?
- Potentials of existing energy supply companies?
- What is the environmental impact of resource usage (especially for local energy sources, such as wood and charcoal, as well as building timber or building materials)?
- Is it necessary to rehabilitate or expand the energy supply company, for instance, in order to supply a new settlement?

Water supply: (see also section 5.1.5.3. (2))

- Demand for drinking water, domestic water (differentiation is often unknown); the amount is more important than the quality of the water (e.g. 40 litres in Eastern Europe per day per person, or 25 litres in Africa per day per person, incl. herds of small domestic animals)?
- Quality of water, is filtering equipment required?
- Water storage (underground reservoirs, cisterns, overhead tanks)?

• Supply by tanker during the start–up phase? Who carries the costs?

• Cost per m^3 of drinking water (provided it can be determined)?

4.5 Target group, risk of conflicts and disaster risk management

Target group and risk of conflicts:

• Rough assessment of the socio–economic structure of the region's population as a whole and in relation to those in need of shelter;

• differentiation of those in need of shelter according to socio–economic criteria and, if necessary, collaboration in the formulation of criteria for the eligibility for acquiring dwelling space or promotion;

• review of the advantages and disadvantages arising for the resident population by the building of new settlements;

• assessment of what kind of cooperation and conflict potentials exist between the resident population or total population having dwelling space and the target group to be provided with shelter, in connection with the building measures;

• homogeneity of the target group to be provided with dwelling space (groups, structure of households, organisation, also regarding vulnerability to disasters);

• assessing the capacities of the target group and taking into consideration when planning; verifying collaboration

– during planning (organisation and representation),

– during realisation (finances, technical know–how, working performances),

– compatibility of participation through work inputs, which generally help to secure the people's existence.

Disaster risk management:

• Inquiring or drafting disaster risk assessment for the land to be built on or which is to be rebuilt; assessing the risk of hazards in cooperation with the population and national institutions (risk of flooding, landslides, lava stream, other exposures);

• inquiring which possibilities exist within the conception of building measures to reduce the risk of disasters:

– disaster–resistant construction for new buildings, repair works, and reconstructions,

– cost benefit considerations,

– applicability of the conception beyond the building measure,

– discussing possible use of early warning systems for earthquakes, floods, volcanic eruptions (e.g. with flood early warning system for the efficient operation of disaster protection measures),

– disaster precaution (e.g. education and training of local organisations, reserve supplies of sufficient disaster–resistant infrastructure, such as emergency shelter for future use).

4.6 Interim result on location

In the course of the assessments on location and after consulting the project executing organisation the NGC's appraiser forms his first ideas on how the envisaged project concept is to be realised. Here, any one of the implementation models described in section 5.1 to 5.3 or appropriate combinations of these can be applied. Not later than at this point the appraiser should contact the people responsible in his home office and discuss the latest developments, the proposed project concept, and further procedures. The home office might have to consult the donor/financing agency.

Subsequently, the appraiser should agree with the project executing organisation on the probable conception and convey the results of the agreements with the financing agency and home office. The results should be recorded as minutes of meeting or notes of discussion, provided that no other procedure was agreed upon with the donor/financing agency. At this point the German Embassy should be consulted with regard to a possible involvement.

Provided there is enough time, a draft offer or part of it should already be written on location during the mission.

4.7 Analysis of the German and international building sectors with regard to emergency shelter

A large number of planners and project developers worldwide are dealing with the planning and conception of emergency shelters. This is taking place within the field of research and education with students at universities, in private architectural firms, or in medium–scale enterprises, where these concepts are manifested in prototypes and model houses. In some cases, these ideas are developed in cooperation with large companies wanting to sell material (e.g. insulated profiled metal sheets) or with manufacturers of prefabricated houses. Well–engineered model shelters for emergency situations hardly exist. This is understandable as developments cost money, the market is unclear, and opportunities for new commissions only occur coincidentally. But there are programmes for the construction of simple buildings for the leisure market (garden houses, log cabins), which are in permanent demand by customers. Manufacturers of prefabricated houses react to inquiries if projects and secure financing are assured. Then, they generally mobilise their subcontractors, for example in Scandinavian countries, companies in the USA, in Eastern Europe, or in low–wage countries, and launch offers. The implementation proposals then follow the NGC's instructions (see section 5.1.5.3 (4)), or they offer their own, relatively simple and adapted products.

Bringing in the German or international building industry is a viable option only if a large number of prefabricated emergency shelters is to be erected. In all other cases of building and rehabilitation measures involving conventional construction, German or international building companies hardly stand a chance on location, due to the costs involved.

In the case of prefabricated buildings, the NGC should insist on turnkey erection on site, including foundation. It is not of much use if the manufacturer is only in the position to supply ex–works or free on construction site and leaves the interface coordination and completion of the service to the NGC. The NGC will then inevitably be confronted with problems. An interface on the foundation's upper edge is basically possible, if the manufacturer of the prefabricated houses is assigned the responsibility for the approval of the foundations erected by a third party. A supply always has to include the assembly of the buildings on site.

As a result of his business experience and connections, the NGC either already disposes of an index of potential manufacturers of prefabricated buildings or he can request the associations of manufacturers of prefabricated houses (also to be found in the Internet) to provide him with a directory of members and further information. Fundamental selection criteria for manufacturers of prefabricated houses are, among others:

- The product proposal is adequate and the offer is complete (including sanitary facilities, heaters, furnishing, etc.);
- proven expert know–how in previous comparable projects (references) exists;
- existing production capacities are sufficient and thus anticipated delivery time can be met;

- turnkey supply is possible;
- international experience in transport, supply, and assembly is evident;
- qualified personnel is available;
- commercial creditworthiness seems to be given, but has to be verified.

Aforementioned technical and commercial selection criteria are to be seen in relation to the price. The relation has to be weighed up and determined according to the situation. A good product that is reasonably priced, but cannot be delivered in the required time, is less likely to be of use to solve the emergency situation on location (see case study B – Azerbaijan).

Case study **B**

Construction of 16 refugee settlements as emergency aid measure in Azerbaijan

Financing agency:	**ECHO (European Community Humanitarian Office)**
Financing volume:	**16,600,000 euros**
Period:	**1993–1996**

After the breaking up of the Soviet Union, hostilities between the now independent states of Azerbaijan and Armenia escalated and reached their peak with the Armenian army's occupation of Nagorny–Karbakh, a region in Azerbaijan mainly inhabited by Armenians. Approximately 1.4 million people, mainly Azeries, as Azerbaijan's citizens are called, fled into the hinterland of Azerbaijan.

A large number of displaced persons had no shelter or food and the new state Azerbaijan was not able to solve the pending problems. ECHO decided on rapid aid and assigned GTZ with the building of simple housing settlements in different regions.

From 1993 until 1996, GTZ built a total of 16 housing settlements with 3,280 houses and 6,560 rooms for approximately 36,000 persons in 4 different building phases. The average construction costs per accommodated person amounted to 558 euros, including all incidental expenses and GTZ overheads, a relatively low price, considering the circumstances and regarding the efficient and appropriate solution reached.

The project implementation of the first building phase, executed in 1993, took place in cooperation with the German Federal Agency for Technical Relief (THW), which established the technical infrastructure (roads with gravel surface, water supply, and street lighting) for the first two settlements. GTZ was responsible for the turnkey erection of all the houses during all 4 building phases. For the building phases 2 to 4 during the years 1994–96, the technical infrastructure was also established by GTZ.

The housing units were simple constructions made of insulated, prefabricated lightweight building elements that could be assembled manually. The housing units were equipped with one lighting connection each and very simple basic furniture. After tendering, the prefabricated buildings were imported from Finland and Turkey. Ventilated pit latrines were built on site and assigned to each housing unit. Centrally located washing and shower houses in conventional construction satisfied the minimum hygienic needs.

The identification phases of the individual locations of the settlements with regard to technical and socio−ecological criteria, took place parallel to the planning and tendering activities and each lasted about 1 month. The building of the technical infrastructure, as well as supply and erecting of the prefabricated houses was achieved with greatest effort in approx. 4 months. Due to the very flexible methodology, it was possible to hand over each of the housing settlements before the onset of winter.

Parallel to the construction work and during the whole construction period, the so−called integration phases with instructions and directions on self−help initiatives, taking−over of personal responsibility, development of the community, and creation of jobs were realised in cooperation with an Azerbaijani NGO.

In building the housing units, the refugees were provided with a first solid nucleus to spend the winter in, with the possibility of an individual expansion through personal contributions later on.

Extreme efforts towards the integration and sustainable development are yet to be made.

5. Project planning and management during implementation

In the course of the rapid assessment the envisaged concept, expected to be suggested, generally becomes apparent to the team of appraisers. This means that concept−specific investigations for the beginning of the planning and first considerations about the implementation of this concept should already be carried out parallel to the rapid assessment.

In this chapter, “contractor models”, “self−help models” and the “building yard model” and their contents and procedures will be presented by examples. Modifications, variations, and combinations are possible. In contrast to the contractor models, where the construction works are carried out by the private industry, in self−help models a considerable part of the construction works is implemented by the future beneficiaries themselves. In this case, support is mostly given through building material supplies and expert advice in construction. Here, the target group is involved more intensively in the planning and implementation of building works, while building contractors are awarded contracts at the most for partial works. Independent of that, in both models a participation of all people concerned (direct target group, population in the target region, administration and authorities) takes place in the planning. All these direct or indirect participants contribute personal inputs in favour of the project’s overall success.

The decision on whether a contractor model or a self−help model is to be applied depends basically on the following aspects:

- Building method in the target region and technical complexity of the building project,
- capacities of the parties involved (technical, economical, organisational),
- conceptions of the time frame for achieving the objectives.

In societies marked by the division of labour, contractor models are the prevailing model of implementation of building measures. Technical advice can be given to the construction industry, e.g. concerning the improvement of building techniques with regard to disaster precautions. Even if contractor models include an external financing of the measure by the donor, sector authorities and administrations provide their own inputs.

If living space is generally provided by self−construction in the region and the basic technique is widely known to the target group, the target group should be included in the construction works within the framework of self−help models, according to their technical know−how. It has to be taken into consideration that the scope of the building works on houses requires a long−term commitment of the workforce, which is not always possible (see 5.2. Self–help models).

5.1 Contractor models

Provided that the expert analysis of construction and the rapid assessment come to the conclusion that, due to great destructions of buildings and technical infrastructure and due to an acute lack of accommodation possibilities for many thousands of disaster victims or refugees, building measures need to be implemented in the shortest possible time – maybe before the onset of winter – implementation according to the "contractor models", as described in detail below, is the appropriate option. This entails a consistent cooperation with the local building industry, in exceptions even with the international building industry. It is not acceptable that in large aid projects the agency responsible for the implementation of the project (NGC) plans the project on its own, recruits personnel, purchases material, and more or less plays the role of the building contractor. It is a fallacy to believe that by doing so expenses are cut down on (by saving contractors' profits, purchasing material at lower rates, and the like), not to forget lacking guarantees and liabilities. Consequently the advice is: consistent cooperation with planners, building companies and suppliers, after their selection on the basis of competitions.

5.1.1 Local and international building industry

For various reasons, media reports on disasters, streams of refugees, and destructions are often exaggerated. Occasionally, international companies gain the impression that almost everything is destroyed and the affected countries are technically not able to solve the problems on their own. Frequently the opposite is the case, except, for instance, when power stations, dams and other plants with special technologies are damaged. Most of the damages, or at least a considerable proportion, can be repaired by the local building industry. Their participation fosters an economic development of the country from the beginning and creates jobs.

Albeit companies only exist fragmentarily in the host country, the required manpower and professional know–how are still there; they normally reorganise themselves quickly and do an acceptable job. The professional qualification of the potential local planning and building partners' executives is decisive. In order to discover these qualifications, detailed interviews have to be held before deciding on a shortlist and awarding of contract. In most cases, and if necessary, with the help of consultations, these companies ought to be considered for the implementation of services or at least for parts of it. The questionnaire (Questionnaire for Architects/Engineers and Contractors), included under item 9.1, can be used as a basis for interviews and making decisions.

Services, which the local building contractor cannot provide, should be covered by appointed sub–contractors (if necessary, international ones) or other independent contractors. Here, a coordination of the interfaces by the NGC is required.

5.1.2 Project controller, implementing consultant, local architects

The NGC, defined in section 1 (Summary) as the responsible agency for the implementation, owes the donor/financing agency the offered service as a whole. In this capacity it has to take the part of the project controller. It is best if the service of project control can be implemented with its own technical and commercial personnel, having experience in development cooperation and being able to make quick decisions. This reduces interactions with other parties, expenses and duration of the project.

Should the NGC not be able to provide these services, they can be subcontracted to a so–called implementation consultant from the German or international market. In case of delegation to an implementation consultant, the NGC still requires at least one expert (a building generalist) within the agency, in order to give instructions to the implementation consultant, to control him/her and to influence or take the necessary decisions. Rough sample TOR for engaging a project controller are outlined in section 5.1.3. Depending on the country in which the services are to be rendered, the implementation consultant may also be found on location.

At any rate, architects and engineers on location should be appointed as partners and subcontractors to carry out the planning and site supervision. They know best about the professional means and building permission procedures, the sources of material supply, the labour resources, and the industrial resources in general. They are familiar with the area and still remain on location after the completion of the NGC's or the project executing agency's measures and can, for example, follow up warranty claims on behalf of the NGC or the project executing agency.

5.1.3 Terms of Reference (TOR) for project control

5.1.3.1 NGC as project controller

Should the NGC dispose of experts within the home office staff and possibly also field staff, the following services should be provided to ensure efficient project organisation and implementation:

(1) Recruiting of personnel, or provision of:

- Project manager (seconded to project location);
- architect(s), construction experts (seconded to project location);
- 1 (building) economist (seconded to project location);
- backstopping – management = project leader (at the home office);
- backstopping – construction expert (at the home office);
- backstopping – contract expert (at the home office);
- backstopping – economist (at the home office).

(2) Project organisation and mobilisation on location

- Renting office space;

- employing local personnel (after interviewing) as: office assistant, interpreter, chauffeur, possibly other professionals;

- equipping offices; computer to be procured on location, if possible, for service and guarantee reasons, otherwise imported;

- installing telephone, fax, possibly e−mail and internet access; possibly satellite telephone;

- importing vehicles; alternatively buying on location or leasing them, after comparing prices;

- opening an account with a bank, if possible, for financial transfer and payment of invoices on location (short periods for payment);

(3) Project activities

Planning and preparation:

- Determining possible planning and implementation concepts with the project executing organisation (see also section 5.1.5);

- concluding necessary project agreement(s) with the project executing organisation(s);

- appointing local free−lance architects/engineers as subcontractors, after interviewing them and inspecting the architects' offices (possibly upon recommendation of the local Chamber of Architects or Engineers, if existing, or of the building authorities, or according to one's own knowledge and research).

Tender and contracts:

- Tender and conclusion of contracts with architects after consultation with the project management at the home office of the NGC (at GTZ, also with the contracts department), directly between NGC and architects;

- pre–qualification and shortlist of potential construction companies (with explanatory statement); verification of construction companies with a view to their qualification as general contractor;

- implementation of the construction tender and analysis; communicating proposal for award of contract (with explanatory statement) to the project leader at the NGC's home office (at GTZ, also to the contracts department for approval);

- direct conclusion of contract between NGC and general contractor for constructions.

Monitoring and controlling:

- Steering the planning of the construction works, carried out by the local architect;

- overall supervision of building progress;

- verification of the plausibility of the contractor's running invoices and the final invoice(s), which have been checked by the local architects;

- remittance of payments, after deducting contractually agreed retention money;

- controlling of project accounts, i.e. administration and financial management;

- dealing with and monitoring agreements with local contractors and local staff (contract procedures, payment etc.);

- acceptance, verification, and confirmation of bank guaranties (the reliability of the bank also has to be checked; it should be connected to the SWIFT transfer system);

- effecting all bank and cash transactions;

- management of overhead and administration costs;

- disbursement of financial resources (salaries of local staff?);

- bank transactions;

- accounts management;

- insurance coverage of the measures (transport, building etc.);

- budget planning (building costs) und monitoring;

- compiling regular financial and expenditure reports;

- invoicing of all measures;

- final commercial invoicing of the project and transmitting it to the NGC's project management.

Inspection/project termination:

- Inspection of the construction works by the NGC or delegation of the task to local architects;

• if necessary, handing over of planning and contract documents to the project executing organisation for the following up of warranty claims. Note: This procedure has to be agreed upon in the building contract;

• drawing up the final project report and possibly a photo documentation according to the instructions of the NGC's project management.

5.1.3.2 Implementation consultant as project controller

In case the NGC does not dispose of the required expert personnel to implement the project control, it can appoint a so−called implementation consultant to take over this task. The latter can originate from the following professional groups: architects, civil engineers, project controllers or infrastructural planners. Essential selection criteria are:

• Experience in project control and management;

• international experience;

• experience in contract procedures in the building sector;

• experience in cooperating with local sub−planners, site supervisors, and construction companies;

• experience in international development cooperation;

• sufficient personnel capacities for secondment to the project (possibly with substitute staff) and for technical and commercial backstopping.

In general the NGC has to look for an implementation consultant via a so−called consulting tender. The TOR for this tender can be derived from the services listed above, under section 5.1.3.1. Such a tender is time−consuming, which is a considerable disadvantage in view of the required immediate action in the disaster region. Direct appointment of consultants is generally possible with large commission volumes, however they require a clear rationale. Depending on the commission volume, it has to be verified whether it is also necessary to observe EU guidelines for the awarding of contracts, which would additionally prolong the procedure.

The description of services of the implementation consultant is almost identical to the services mentioned under the above section 5.1.3.1, for the case of the NGC taking over the project control. However, the terms of cooperation with the local architectural and engineering firms may differ. In any case, the implementation consultant will raise extra charges on the local firms' services, since he assumes responsibility for their services vis−a−vis the NGC.

5.1.4 Contracts and awarding procedures

Contract drafting procedure

Procuring of company information, company visits, interviews (QUARENG)

Initial meeting to draft shortlist and tender documents

Dispatch of tender documents (e.g. INVTD150 or INVTDFID)

Drafting of tenders by construction companies (e.g. TENDRFID)

Possibly public opening of tender

(see “Minutes of opening tender” – MOPTENDR)

Tender analysis

(calculation and technical appraisal by the architect)

Proposal for awarding of contract, and documentation

Decision on awarding of contract

Contract negotiation,

if necessary, corrections of bill of quantities (BoQ)

and completion of contract and planning documents

Mobilisation/preparation and commencement of project

Even if time pressure is high in crisis situations, the required procedures (however, with considerably shorter deadlines) hardly differ from those under normal conditions. Therefore, wherever possible and reasonable, awards should be effected on the basis of tenders. Controls and the transparent use of funds, as well as suitability for appraisal through respective auditing authorities, are too important to dispense with tenders.

In general, it is unqualified to reason that, due to the urgency of emergency aid building measures, contracts should be awarded directly. In all cases, specifications and bills of quantities will have to be drawn up before the awarding procedure. Without these, commissions have no basis and cannot be placed. The additional work or delay in time is only incurred due to the search for alternative tenderers and the need to analyse several tenders instead of just one. This takes up little extra time. However, obvious advantages lie in the proven economic efficiency and security to have engaged the most favourably priced (not necessarily the cheapest) tenderer. Negotiations can be conducted more efficiently if alternative offers exist.

The following sample documents of GTZ in connection with tenders and awards are included in the annex of these Guidelines:

9.1 Questionnaire for Architects/Engineers and Contractors (QUARCENG)

9.2 Bidding Conditions for Consultants, Architects (BIARCENG)

9.3 Contract for Architectural Consulting Services (CONTRARC)

9.4 Form of Cost Estimate (COSTESTM) and Explanatory Report (EXPLAREP)

9.5 Form of Invitation to Tender for Construction works (recommended for contracts value up to 150.000 Euro) (INVTD150)

9.6 Form of Invitation to Tender for contract value above 150.000 Euro (INVTDFID)

9.7 Tender Conditions for Contractors (TENDRCON)

9.8 Tender Form for contracts above 150.000 Euro (TENDRFID)

9.9 Minutes of Opening of Tenders (MOPTENDR)

9.10 Contract for Construction Works on Measurement Basis (recommended for contract value up to 150.000 Euro) (CONCTRMB)

9.11 Specimen of Performance Guarantee (GARANTPF); Advance Payment Guarantee (GARANTAP); Guarantee for Defects Liability Period (GARANTDL)

9.12 Specimen of Construction Progress Report (PROGREP)

9.13 Form of Certificate of Taking−Over (TAKGOVER)

9.14 Form of Certificate of Handing−Over (HNDGOVER)

9.15 FIDIC−Part I, Conditions of Contract for Works of Civil Engineering Construction (recommended for contract value above 150.000 Euro) (FIDIC−P1) Website Information.

9.16 FIDIC−Part II, Conditions of Particular Application (as an example), drafted by the GTZ (FIDIC−P2), to be adapted to the specific project conditions;

The annexes mentioned above are also available in French and partly in Spanish in the building section of GTZ and the GTZ contract department. The sample documents are drafts based on special requirements, conditions and conceptions of GTZ. With every new project they have to be verified with regard to their suitability, negotiated accordingly and adapted.

Large building contracts (commission volume exceeding 150, 000 Euro) should not be concluded without the support of a contract expert.

For all GTZ projects exceeding this volume the GTZ contract department has to be involved, as stipulated in the GTZ (internal) Orientations and Rules (O + R).

The contract forms mentioned above are based on common international forms and have been successfully applied by the legal and contract departments as well as the building section of GTZ for many years. It may seem that some of the documents are too detailed and thus inappropriate for application in developing countries. However, practical experience has shown, that contractors have so far not objected to the application of these updated contracts, and lawyers of the local companies have appreciated and accepted them due to their balanced content. International donors, the EU, and KfW, also insist on the application of FIDIC contract forms. They constitute internationally recognized contract conditions and guidelines for the implementation of building measures worldwide. They are published by the "Fédération Internationale des Ingénieurs−Conseils (FIDIC)" in two parts. Part 1 includes the general conditions, while part 2 refers to project−specific guidelines and thus has to be adapted to the special conditions of the respective project. Further information as well as order forms can be found on the Internet under "www.fidic.net".

The application of the German fee scale for architects and civil engineers (HOAI), even with adaptations, is unsuitable. It is specific to Germany, too complicated, inappropriate for developing and emerging countries, and also unknown to them. Regarding building tenders, the same applies to the application of or reference to the German contract procedures for building works (VOB), when specifying construction works. The VOB is tailored to the German construction market, to high standards and agreements with German companies, and thus unsuitable − even more so for emergency measures. The remuneration as a percentage of the production costs is a possible and widespread way of paying for the services of architects and civil engineers. Depending on the job description, the rates can vary from 5 to 12%. The architects' and engineers' services have to be precisely defined before contracting them. The sample contract “Contract for Architectural Consulting Services” (CONTRARC, item 9.3), can be applied. It has to be adapted accordingly. Architects should only be contracted after having obtained several tenders and having conducted negotiations. In the case of easily comprehensible planning tasks, an effort should be made, together with the architects and engineers, instead of remuneration as a percentage of the production costs, to agree on a lump sum (fixed price), which can only be changed in the case of substantial variation of services.

As far as possible, construction works should be awarded to general contractors on location, in order to minimise interactions across borders. Separate tenders for different categories of construction work, as are common in Germany, should be avoided; otherwise all coordination services are left to the project controller.

Building contracts should be agreed on as measurement contracts, and not as lump sum contracts, because unforeseen events are common with emergency and reconstruction measures and a measurement contract reflects the situation, fair to both sides, as payment is effected according to the actual services delivered (exact number of pieces, quantities, sizes, etc.).

After completion of the building measures, warranty claims towards the NGC’s planners and construction companies are passed on to the project executing organisation, as the NGC usually retreats from the region while the warranty period persists. This has to be agreed in the contract.

5.1.5 Planning and implementation concepts

It is assumed that the intended implementation concept had already been determined roughly during the rapid assessment, in cooperation with the project executing organisation. It was included in the offer to the financing agency and forms the basis of its commission. Three possible concepts are presented as examples, which can be applied in combination and thus provide the project executing organisation with some degree of flexibility.

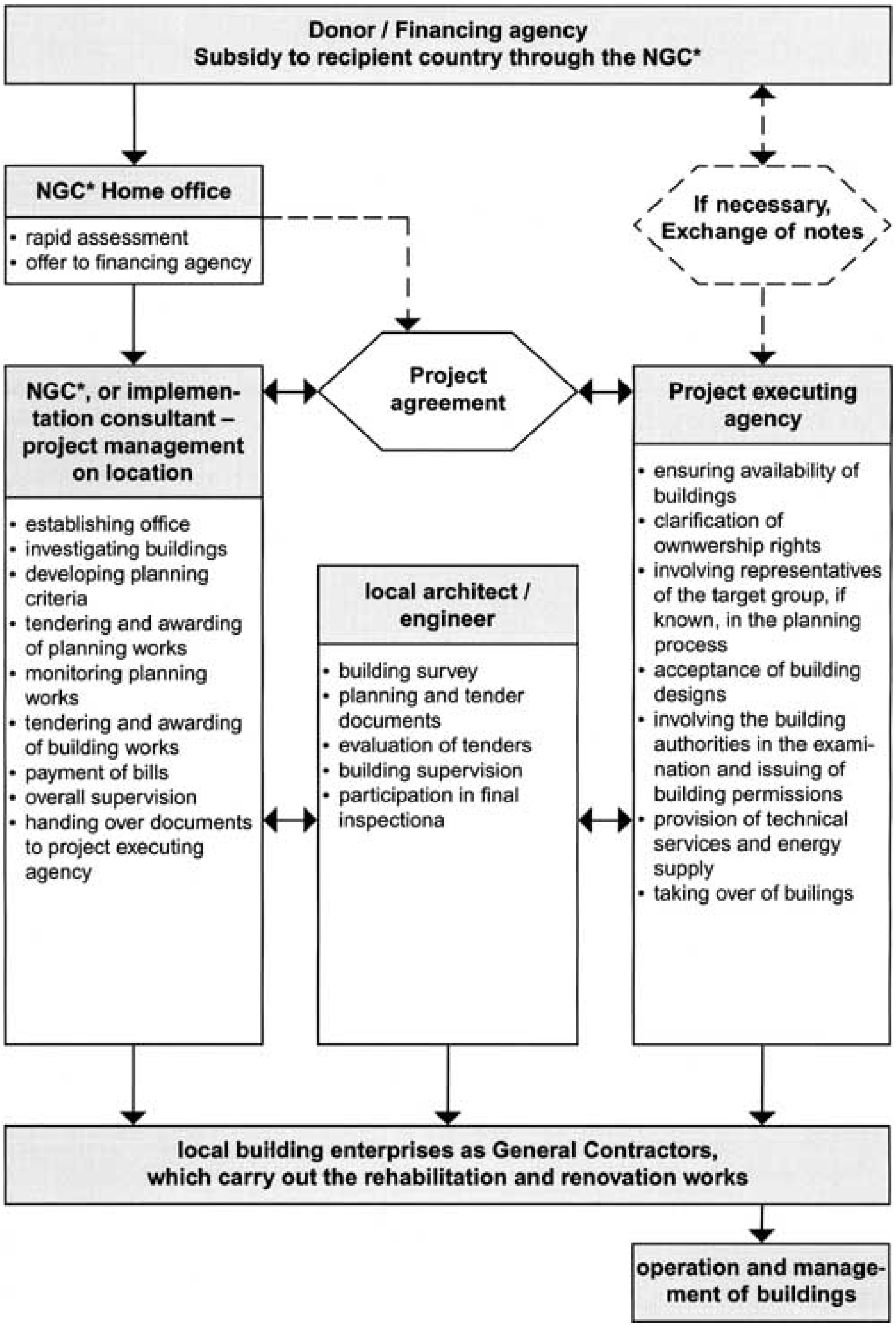
5.1.5.1 Rehabilitation and rededication of public buildings

Unused and vacant public buildings are often suitable for the short–term accommodation of disaster victims and refugees, after being rehabilitated or reconstructed accordingly and equipped with adequate toilets, washing places and heating facilities. These can be former military barracks, administration buildings or similar buildings. In general, the local authorities quickly have a good overview of the situation. It should, however, be made sure that such buildings are located sufficiently close to neighbouring settlements (social contacts) and are not exposed to environmental pollution. The advantage of public buildings lies in the fact that the question of ownership and thus the right of use is generally clear, the buildings usually are or were connected to technical infrastructure (water, sewage, electricity) and thus dwelling space can be provided very quickly, sometimes with little effort. In the early stages of planning, together with the project executing organisation, thoughts should be given to possible future usage, which should be reflected in the floor plans, provided that they are justified and the extra costs are not too high. The buildings can possibly be used later as administration buildings, schools, kindergartens, small trade, tenements and the like. This kind of accommodation is preferred due to its higher sustainability and the distribution of benefit to everyone.

At the beginning of the planning phase, it has to be verified whether building permits are required.

In the case of several large buildings requiring a considerable planning volume, it is advantageous to commission two local planning offices. This reduces planning time and creates a certain competitive situation.

5.1.5.1 Rehabilitation and rededication of public buildings



* NGC = non–commercial general contractor

5.1.5.2 Rehabilitation of houses destroyed by war

(1) Private houses

This form of project can make sense if large masses of refugees/returnees or displaced persons are in the country, who want to return home or have to be repatriated and accommodated since they are not able – for whatever reasons – to return to their original houses and region. In pacified regions, partly destroyed private buildings can be repaired or rehabilitated with assistance funds by contractors, on the condition that the owner of the house in return offers shelter in his house to a number of refugees free of charge for a certain period of time (about 2–3 years). This has to be stipulated in a written agreement between the owner of the house and the local administration or refugee office. Such a concept guarantees reliable and rapid repair of numerous buildings. It supports the local population's existing readiness to help and is of benefit for numerous groups.

During a first inspection, the degree of destruction and thus the eligibility for promotion in relation to the opportunities of sheltering refugees/displaced persons are verified. After determining the buildings eligible for promotion, the damages are assessed, the required services identified, and the quantities calculated by local architects, according to the NGC's specifications and on the basis of forms specifically created for this purpose. This simple form of assessment is possible, as damages of individual buildings are generally similar. In this way, technical specifications are produced, which, together with diverse contract documents listed in section 5.1.4, constitute the tender documents.

The restoration of houses should be simple and only deal with the most essential works: all structurally indispensable works, the roof, bathroom, WC, windows (made of insulating glass, if possible, on location), staircases, simple doors, and interior plaster. It is left to the owner of the house to contribute to standard improvements at his own expense.

Calculations of space required per refugee should be fixed at a minimum of 4.5 m^2 and should only apply to dwelling space. Sanitary rooms and circulation space are additional. The subsidy increases proportionately to the number of refugees that can be accommodated in the house.

The rooms of the refugees or displaced persons should be furnished simply by the NGC, the administration, or other aid organisations, with beds, 50% of them bunk beds (problem of acceptance), chairs, tables, cupboards, and each with one simple cooking facility.

The works done by the local general contractor have to be measured and approved by the local architect. The NGC conducts random inspections. A guarantee period of one year should be agreed on.

Case study **C**

Provision of winterised shelter for displaced people and rehabilitation of schools in Tuzla Canton, Bosnia & Herzegovina

Financing agency: **Federal Republic of Germany, represented by BMZ**

Financing volume: **6,698,000 euros**

Period: **1995–1997**

Even before the signing of the Dayton Peace Agreement, BMZ decided at short notice to contribute to the accommodation of refugees and displaced people in Central Bosnia and charged GTZ, amongst others, with the implementation. In the Tuzla Canton alone, about 240,000 displaced people and refugees were given shelter in addition to the approximately 700,000 inhabitants. The attack on the enclaves Srebrenica and Zepa in the late summer of 1995 resulted within a few days in a streaming into the Tuzla Canton of an additional 35,000 displaced people, especially women, children and old people, who could only be temporarily accommodated for the moment, partly under inhumane conditions in tents and mass accommodations.

In order to achieve better results quickly, GTZ realised several implementation models simultaneously, each in close cooperation with NGOs, which were already active on location, and the partly intact local building authorities of the affected townships:

1. Private houses were repaired or extended and simply furnished under the condition that the owners committed themselves to take in refugees for the period of, for example, 3 years.

2. Shared building components, such as the roof, staircase, windows, outside doors, chimneys for heating stoves (but

not central heating), and water supply, were repaired in partly destroyed municipal apartment houses, while the returnees did the repair work inside their apartments on their own.

3. Community–owned buildings no longer in use were either extended to become well–equipped community shelters or small simple apartments.

4. A settlement with new four–family houses already under construction was enlarged by 15 houses (60 apartments).

Economic efficiency of the measures was achieved once the stipulated area of approx. 8 m^2/person was attained. Buildings and apartments were provided with minimum furnishing (beds, wardrobes, tables, chairs, hot plates).

After rehabilitation and basically equipping partly destroyed village schools, they were handed over to the school authorities for resumption of classes. On the other hand, large school buildings or public buildings in Tuzla, which had temporarily served as mass accommodations and were vacant again, were rehabilitated and returned to their initial purpose.

Besides Tuzla (30 buildings), the measures extended to Zivinice (100 buildings), Gracanica (22), Prutace (15 new buildings), Banovici and Srebrenik (42), Kalesija and Celic (127 dwelling–houses and 148 apartments).

A total of 5,721 refugees and displaced persons were accommodated within the reconstruction and restoration measures. In applying a mixed calculation, accommodation costs of 1,171 euros per person arise, including all incidental expenses and overheads.

The programme represents a successful example of development–oriented emergency aid. The personal contributions and self–help of house owners, displaced persons, returnees, local authorities, construction companies, workers, and engineers together contributed to the success of the measures, despite the difficult conditions in winter. They provide the condition and hope for the sustainability of the results achieved.

(2) Private or public tenements/apartments

Here too, the degree of destruction of the buildings is the decisive factor of eligibility for promotion. Should this be the case, the measures should primarily concentrate on all structural measures and measures involving community facilities. These are, among others, the roof, external insulation, outer walls, all load–bearing structural parts, windows, staircases, entrance doors to the apartments, electricity, water, and sewage. External plaster and external paint should not be included, in order to avoid arousing envy amongst the less supported neighbours. Inside the apartments: a simple bathroom (shower, WC, wash basin) without tiles, tap and simple cooking facility in the kitchen, and wall plaster. It is a question of budget as to which other building components can be installed inside the apartments (floor covering, interior doors, wall paint, wall tiles). It could also be expected from the owners of the apartments or buildings themselves. The interfaces are to be fixed from case to case.

Possible beneficiaries are, for instance, former apartment owners, who have returned to the buildings, or displaced persons/refugees from outside who temporarily occupy apartments.

Building investigations, planning, tendering, awarding, implementation, inspection, and warranty must be treated as described under the above item (1), “Private houses”.

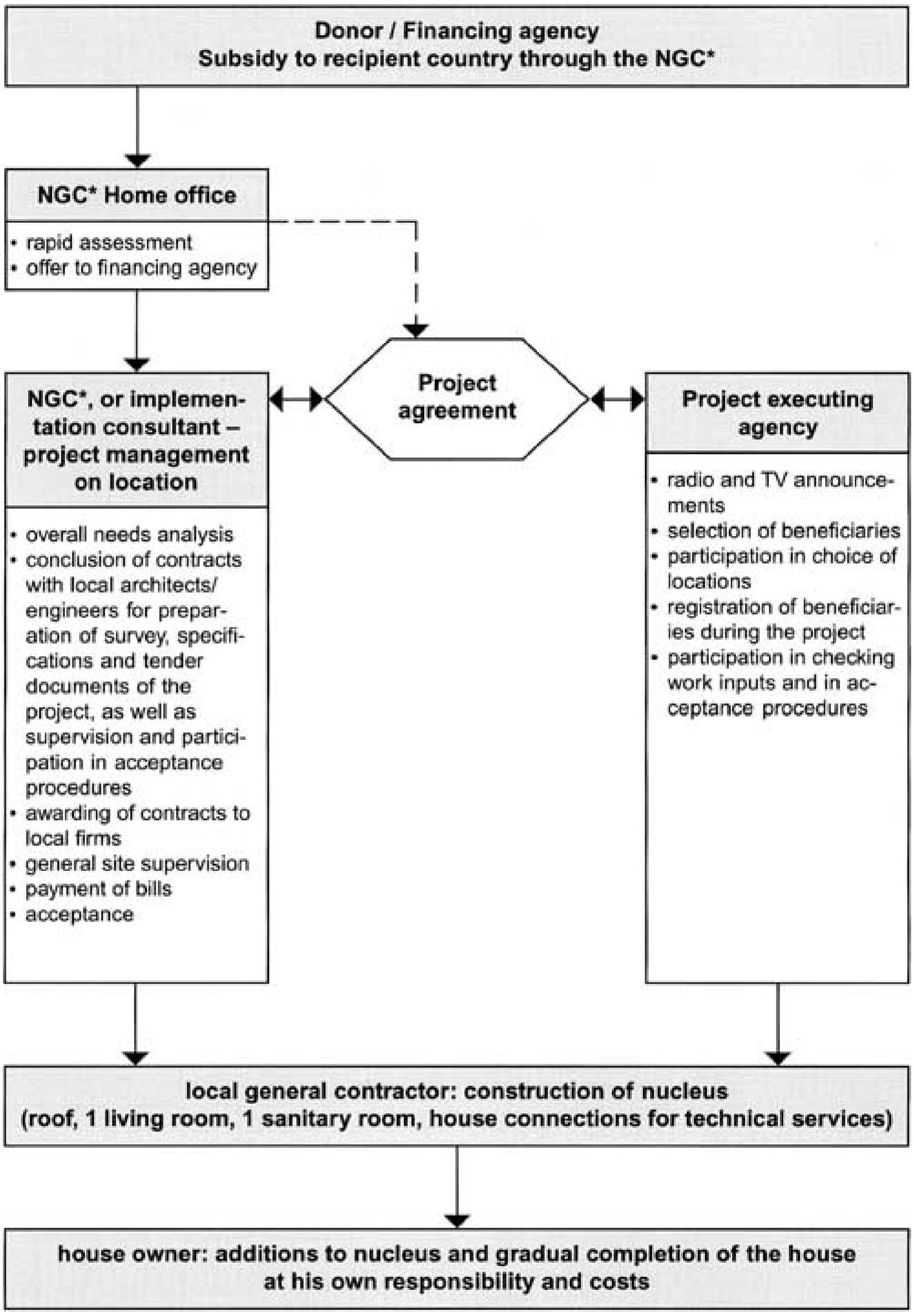
(3) Nucleus model for the rehabilitation of private houses

If the aim is to give as many local families as possible a stimulus for the reconstruction of their destroyed houses with little assistance funds, even without the obligation of accommodating refugees or displaced persons, as mentioned under section 5.1.5.2 (1), “Private Houses”, a so−called nucleus model can be realised. After assessing the eligibility for promotion (degree of destruction, neediness) through local architects, according to the NGC’s specifications, the promotion generally comprises the following: provision of basic infrastructure (water−supply point, power connection), the roof of the building, 1 living room with windows and doors, 1 wet cell with shower or tub, WC and wash basin, including door and window.

Just like in the preceding models under section 5.1.5.2 (1) and (2), the architect assesses the damages, describes the specifications, calculates the quantities and draws up a tender for the respective amount of buildings. The awarding, implementation, measurement, inspection and warranty must be carried out as described before.

No further measures will be executed on other rooms or parts of the house. It is up to the apartment owner to further complete the building at his own responsibility and with his own financial resources.

5.1.5.2(3) Nucleus model for the rehabilitation of private houses



* NGC = non–commercial general contractor

The selection of beneficiaries is carried out together with the local authorities in charge of reintegration and reconstruction. In case the number of buildings and applicants exceeds the possibilities of financial support within a region, the beneficiaries should be publicly selected by drawing lots. This procedure could also apply to other models.

(4) Rehabilitation through financial contributions

In case the project executing organisation is in the position to provide its own qualified professional resources, these are usually building or planning authorities with their experts, the rehabilitation procedure can also be effected via financial contribution. However, a detailed and critical examination of the management personnel through interviews, the office capacities, the equipment, and the general performance capability of these authorities has to be conducted by the NGC beforehand. It is true that community building authorities worldwide do not have the reputation of handling projects quickly. However, in cases of emergencies and disasters affecting all the people in the community, i.e. friends, relatives, and themselves, the motivation to work with greater commitment can be extremely high. Samples of Financing Agreements are not included in these Guidelines. They are only meant for internal GTZ use and can be viewed at the GTZ contracts division.

Case study **D**

Restoration and reconstruction of war damaged buildings in the Fizuli Region in Azerbaijan

Financing agent: **ECHO (European Community Humanitarian Office)**

Financing volume: **2,090,000 US** $

Period: **1997−1998**

At the beginning of 1997, in the course of a joint initiative of UN and EU institutions in favour of the repatriation of refugees to former front areas between Azerbaijan and Armenia, ECHO assigned GTZ; with a trial implementation of restorations and reconstructions in cooperation with ARRA, a government organisation from Baku, which is a state−run organisation in charge of the coordination of all projects for the Azeri refugees and displaced people, as well as the executive committee of Rayon Fizuli. The measures were to serve as stimulus for further personal contributions.

The realisation was exclusively achieved by local staff (engineers, skilled and unskilled workers). Up to 200 unskilled persons were trained “on the job” in the building trade.

A total of 500 houses, divided into categories of different degrees of destruction, were repaired for 548 families, while in general only 1 to 2 rooms were provided with windows and doors, the roof was repaired or newly built, whereas the rehabilitation works beyond that were left to the inhabitants (nucleus model), Where required, hand−pumps for drinking−water were re−installed and simple toilets (ventilated pit latrines) were newly constructed.

A micro concrete roof tile production was initiated through the establishment of two new enterprises in cooperation with Parry Associates (United Kingdom) for technical advice, and KOSIA−SMEDA, one of the NGO’s supported by GTZ in Baku, for commercial management consulting. A total of 44 buildings were roofed with the new material.

The project was completed in 1998. After settling the Nagorny−Karabakh conflict, the population continued with the rehabilitation of further houses on its own.

The average costs of a building’s restoration, including all incidental expenses, costs for the production of roof tiles, and GTZ overheads, amounted to 3,814 US $ per family or 763 US $ per person to be accommodated, assuming that one family consists of 5 persons.

The handling of a financial contribution in emergency and disaster situations requires special control of all activities and measures, that are carried out by the project executing organisation and the actors, the building authorities. Temptations and possible preferential treatments (nepotism) can be especially high in crisis situations. Decisions on the selection of objects in particular, are to be taken jointly with the project executing organisation and the building authority, and confirmed in writing. Here, a representative of the NGC has to be involved. The degree of building destruction, rehabilitation costs, and future use in view of the problem to be solved (e.g. temporary accommodation of refugees, returnees) are to be brought into line economically. Planning and tender documents have to be appraised sporadically by the representative of the NGC to check their plausibility. Likewise the quantitative statements of the services provided. The awarding procedures have to be carefully checked, and, if necessary, particularly significant awarding proposals should be confirmed by the NGC.

It must be agreed in the contract that the transfer of funds to the project executing organisation is implemented in stages, according to the progress of the building works, so that the project can be controlled via the funds. It has to be verified whether the NGC's representative should also sign the contractor's invoices to confirm them. It is true that this is not in line with the philosophy of financial contributions, which require independent action by the project executing organisation, but it can be appropriate in particular situations.

The great advantage of the model "Rehabilitation through financial contribution" lies in the fact that rehabilitation and reconstruction are almost exclusively associated with personal contributions, i.e. self-help, by the project executing organisation and its affiliated structures, thus securing jobs in the administration. The condition is, however, that efficient structures exist. In disaster situations and post-conflict regions, a financial contribution should always be granted in connection with an external controlling entity (e.g. NGC). In this model, delays have to be taken into account.

(5) Credit financing

In great emergencies and immediately after disasters and acts of war, public and private aid (donations and the like) lead to measures that are financed by grants, as gifts or financially lost subsidies. Experience has shown that in this way only a relatively low percentage of the affected is reached. After the situation has calmed down, credits by development and reconstruction banks (e.g. ADB, KfW, various funds) can be granted to private house owners for reconstruction work at very favourable conditions. These banks are prepared for such aid programmes and dispose of ready-made models. Understandably, the procedures for these models are lengthy. However, they can reach a greater number of affected persons and promote their self-initiatives. The respective authorities in the affected country (e.g. Ministry of Construction) have to contact the banks.

Case study **E**

Housing and social facilities for earthquake victims in Western Turkey

Financing agency:	**Federal Republic of Germany, represented by BMZ, Republic of Turkey, represented by the Ministry of Public Works and Housing.**	
Financing volume:	**BMZ, for shelters and social facilities:**	**11,250,000 euros,**
	for a temporary emergency hospital and med. equipment:	**767.000 euros**
	German contribution:	**12,017,000 euros**
	Republic of Turkey, for the technical infrastructure, about	**5.625.000 euros**
	Total costs	**17,642,000 euros**
Period:	**1999–2000**	

On 17 August 1999, an earthquake of magnitude 7.8 on the Richter scale, destroyed more than 1,000 mostly four-storey houses in the Marmara region in Western Turkey. The number of lives lost was officially estimated at approximately 15,000. According to the Turkish Ministry of Construction there was an urgent need to accommodate about 120,000 people in temporary, winterised shelters.

The German Federal Government, represented by BMZ, agreed to have shelters erected for approx. 9,000 earthquake victims in Alançuma, Bolu-Karaçayir and Bolu-Karayollari, and assigned GTZ with their implementation.

The Turkish contributions comprised the provision of adequate land, the preparation of the sites, as well as the construction and provision of the required technical infrastructure (drinking-water, sewage system, energy supply, and roads).

The German contributions included the supply (including foundation) and turnkey erection of temporary dwellings, including a sanitary unit, small kitchenette, electric heater, and basic furniture. Tenders for the building works were launched on the Turkish market and a Turkish construction company was commissioned with the supply and furnishing of the prefabricated houses. Supported by the GTZ office in Ankara, GTZ coordinated, controlled, and monitored the works.

After a second severe earthquake on 12 November 1999, in the Düzce/Bolu/Kaynasli region, BMZ provided GTZ with a further 767,000 euros as additional commission for the building of a temporary emergency hospital in Düzce and for the supply of mobile medical equipment. Already at the beginning of 2000, still during winter, people moved into the first shelters. On 7 April 2000 the Turkish President Süleyman Demirel and the German Federal President Johannes Rau, officially inaugurated the Bolu–Karayollari settlement. In total, 1,608 housing units for more than 9,000 earthquake victims, and in addition 2 schools (8 classes), 2 kindergartens, 3 women's centres, 3 social centres, 3 health stations, 3 administration buildings, 2 youth centres, and 3 assembly buildings, had been erected by GTZ.

The costs of the German and estimated Turkish contributions amounted to approx. 1,875 euros per earthquake victim, including all incidental expenses and GTZ overheads.

5.1.5.3 Construction of new housing settlements

When streams of refugees with many thousand people cross the borders to the neighbouring countries without having sufficient accommodations there, the building of temporary housing settlements is often immediately considered an option, sometimes without the decision making bodies being clearly aware of the conditions and consequences.

For the building of new housing settlements, immense efforts are required and the highest expenses arise in relation to all other comparable emergency shelters per accommodated person. The building of settlements is extremely time–consuming and commits the local authorities to operate and carry the costs of these settlements for a long time. A permanent utilisation is to be expected as, for the most part, permanent settlements develop out of the temporary settlements due to housing shortage. That is the rule.

In case the decisions still lead to housing development, the following has to be pointed out:

(1) Choice of location (see also section 4.4)

Most important is the choice of location. It is to be pushed with all available means from the beginning, since the procedure is relatively time–consuming due to the numerous criteria to be considered (property rights, land use plans, exposure to hazards, infrastructure, costs, and many more). The project executing organisation, or authorities contracted by it, have to submit proposals for alternative sites. The NGC's representative has to verify these. For social reasons the site should be reachable on foot at an acceptable distance from an existing village or town (school attendance, shopping, medical care, authorities).

For greater distances, the local authorities have to establish bus connections. The locations are not to be exposed to pollution.

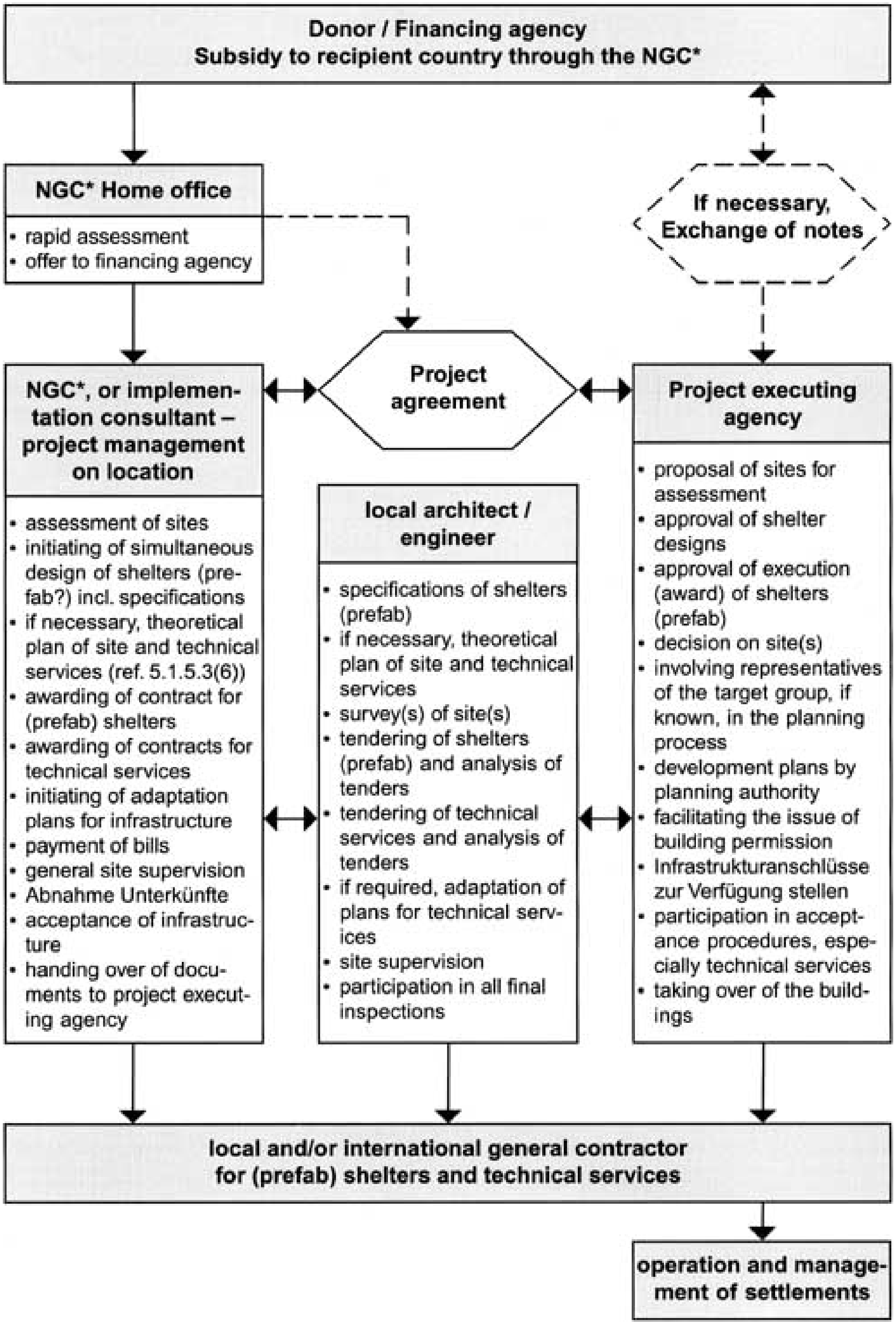
In case, for example, the location is incorrect, or the chosen standard was too low, or errors were made in the planning concept (social, religious customs were not taken into account), settlements may not be accepted by the original target group. This risk underlines the meaning of the choice of location.

(2) Site selection criteria (see also section 4.4)

Experience shows that in the case of dense layouts a site area of 45 m^2 per person is needed. This includes all required spaces for streets, paths, social buildings (schools, administration, kindergarten, etc.), playgrounds, and a small strip around the shelter for gardening. This scale should be set as a goal – however, smaller surfaces are conceivable, if the technical and social infrastructure are partly covered otherwise.

The size of the housing settlement(s) to be planned should not exceed 2,500 people, in order to limit the impact on the environment and to be able to establish a manageable internal settlement administration. Smaller settlements have the advantage that the provision of energy and infrastructure can be solved more easily. All reflections regarding the planning of settlements should ensure that dimensions and standards do not exceed those of the local population, in order to contain their envy.

5.1.5.3 Construction of new housing settlements



* NGC = non–commercial general contractor

Case study **F**

Construction of new housing for refugees returning to Gradacac/Modrica, Bosnia & Herzegovina

Client: **The city of Düren, with financial support of the EU, the Federal State of North–Rhine Westphalia and BMZ**

1,252,700 euros

Financing volume:

Period: **1998**

The repatriation of refugees to their home country is usually associated with a number of problems and unforeseen events, especially if refugees are granted asylum in a Western European country and have settled there. The city of Düren found a solution, which has attracted much attention, both nation−wide and internationally:

Already in 1992, the City of Düren took in to a large number of refugees from the community of Modrica, a village in the Bosnian Serbian region Republika Srpska, and tried intensively to repatriate them. At the beginning of 1998, after lengthy and difficult negotiations, the City of Düren succeeded in obtaining the permission to build a “temporary” settlement and shelter in the community of Gradacac for precisely these refugees in Düren. Gradacac is situated near Modrica, the home town of the refugees. It was, however, separated from Modrica, by the so−called “ethnical demarcation line” between the Bosniac Croatian Federation on the side of Gradacac and the Republic Srpska on the side of Modrica.

In March 1998, the City of Düren charged GTZ with the erection of a completely new settlement of 61 housing units near Gradacac. Five types of apartments different in size enabled accommodation made−to−measure. After a tender, prefabricated houses produced in Bosnia and the technical infrastructure were erected by a Bosnian general contractor under GTZ’s coordination and control.

In September 1998, six months after the commissioning, the repatriation of the refugees from Düren could be carried out. 2,354 m^2 dwelling space had been created for 61 families, including 203 returnees, at the price of 461 euros/m^2 and expenses of 5,345 euros per person. The development costs included (water supply, sewage system, supply of electricity) were extremely high at 1,917 euros/person, but absolutely inevitable.

The high expenses were the result, among other things, of the high demands of the host community of Gradacac, which intends to use the buildings after the departure of the refugees to Modrica for as long as possible for their own purposes, which is why they insisted on having larger floor space per person.

The community of Gradacac also insisted on the construction of an access road for the region, which would not have been necessary for the refugee settlement. As a compromise, the construction and the expenses of 166,200 euros were then accepted. If these expenses are taken into account in the costs of repatriation per refugee, total expenses of 6,170 euros per refugee arise. However, in the long run, this road is very important for the development of the region.

Nevertheless, the project paid off and was worthwhile in three respects: for the city of Düren the return on the investment costs was quick, since the living costs provided per refugee are very high in Germany. The refugees live close to their hometown and meanwhile (2002), coming from Gradacac, some of them were able to repair their houses in Modrica or even return to Modrica completely. The community of Gradacac will now receive new adequate dwelling space for their own use and an access road for a sustainable development.

The technical conditions of a site are: weatherproof road connections (also open to lorry traffic), connection to electricity supply, other energy sources (if available, e.g. gas), water supply, sewage mains or proximity to drainage canal. Should all of this not exist, it is necessary to install autonomous systems. This means, for example, the construction of bore wells or dug wells with overhead storage or pressure tanks, power generator, sewage plant, supply of solid fuels, and the like. Self−sufficiency requires considerably higher investment, operation and maintenance costs. The settlement facilities mentioned above refer to regions with a relatively high standard of living (Balkans, Western Turkey). The construction of settlements can, however, also become necessary in substantially less developed regions, where just the simplest technical infrastructure is adequate. Consequently this may mean: simple water supply through centralised water taps, construction of latrines, and simple electricity supply with lower capacities per housing unit.

As far as possible, the site should have a slight inclination of 1% and more, but not exceeding 7 to 8%. With steeper sites, the higher development costs (such as retaining walls, escarpments) bear no relation to the investment in the building. With regard to the sewage plant and overflow discharge, the inclination of the site has to be oriented towards the drainage canal. As an alternative to the drainage canal, underground seepage or oxidation ponds for biological purification of sewage are conceivable.

The highest ground−water level should not be higher than 3 m below ground, since otherwise natural slopes are not sufficient for sewage disposal and dirty water pump systems will be required (maintenance and repair problems).

The condition of the ground should facilitate the construction of sewage ducts, cable trenches and the like.

(3) Energy supply (see also section 4.4)

The provision of fuels for cooking and heating often constitutes the biggest technical supply problem. In general, wood as fuel does not apply, as the required quantities would be too large. In exceptional cases, the region disposes of coal or brown coal deposits, enabling a controlled fuel supply of the households via the settlement administration. Storage capacities per housing unit would have to be created for this. Paraffin/kerosene stoves and lamps are offered by specialised manufacturers, however, the local market must be able to ensure the paraffin supply. The same applies to the supply of propane gas or natural gas and devices. In regions with almost sufficient electrical energy supply, electric heaters are conceivable. This kind of supply is elegant and can be easily realised, but is generally expensive. With the help of small financial contributions of their own, the consumers should be made aware from the beginning, as to how significant and expensive the energy supply is. Meters for water, electricity, and, if necessary, natural gas should be installed in the housing units from the very beginning. They create the conditions for future accounting procedures and economic consumption.

(4) Emergency shelter

From experience, the choice of locations for one or more settlements takes a long time and precious time is lost. This time ought to be used to start immediately − independent of location decisions − with planning, tendering and awarding of shelters, usually prefabricated buildings, parallel to the search for the site. In certain circumstances the same can apply to the planning and tendering of technical services. Further information on this is given in the following item (5), “Settlement planning and technical services”. For “Basic planning criteria for simple buildings worldwide” see the explanations in chapter 6.

Should the situation permit the erection of the complete settlement, i.e. prefabricated houses and technical service, by a general contractor, both tenders have to be launched at the same time. However, a separation of these tenders is common. It is not unusual that the regions of the new settlements and the production locations of the prefabricated houses are located in different countries, thus joint ventures cannot be formed at short notice.

Emergency shelters are always housing units with one or better still two small rooms (for privacy), and depending on the standard, either with or without WC/shower and cooking place in the house. It is advisable to combine two housing units to a semi−detached house. Combinations of more housing units, for example, as terrace−houses, are also conceivable. However, they affect the privacy and identification of the people with their temporary homes, due to the limited distance between them. Furthermore, the development of small gardens or individual extensions of the buildings by the resident is more or less impossible. Building extensions, with varying success, are often to be observed.

For housing units, only one but no more than two standard floor plans should be realised. The problem of different floor plans is that with the expected change of occupants in the course of time, the dwelling that just became available is most likely to be unsuitable for the new family, being either too large or too small.

The space requirements can vary from 3.5 to 6.0 m^2 per person, depending on the budget situation and the way the disaster victims or refugees used to live in their former homes. These spatial requirements are confirmed by UNHCR and have been realised in numerous projects by GTZ and NGOs. It should not be forgotten that the focus is on temporary emergency shelters and that the prime aim is to repatriate the affected people as fast as possible to their homes or original housing area.

Even if the accommodations are only temporary it is to be verified whether a building permission has to be obtained from the local building authority.

The chosen construction of the shelters must be resistant to earthquakes and storms. The manufacturer must provide verifiable structural analysis and plans.

General technical specifications are the basis for a tender of emergency shelter and should enable the manufacturers of various materials and technologies, who fulfil the conditions, to offer their products. An offer should always be turnkey, which means complete, including transportation and assembly on site, preferably also including the construction of the foundation on site, so that the supplier is responsible for dimensional accuracy. Water, including the shut–off valve, and sewage have to be offered frost–free up to 1 m outside the house. The service company builds the inspection chamber. The electrical installation must be supplied including fuse box and transmission relay to an overhead cable or an earth cable. An overhead cable is generally less expensive. The coordination of the interface from the dwellings to the technical services is the responsibility of the project controller's site supervision. The specifications of the dwellings should contain data – depending on the climatic region – on the minimum thermal insulation of the floor, roof and walls, the maximum wind and snow loads, as well as details of windows (small sizes, insulating glass or at least 4 mm single glazing) and insulation of exterior doors. Internal walls should not be made of metal, but of chip board, plywood or plain wooden boards. Fire retardant material is desirable. The specifications should include a floor plan and section drawing of the shelter (scale 1:50).The clear height of the rooms should be 2.35 m on average. The roof overhang is meant to discharges the rainwater away from the house, but in order to avoid damage in storms, it should not exceed approx. 30 cm, depending on the material.

Many suppliers affirm to be able to build emergency shelters. The essential criteria for selecting manufacturing companies are:

• Appropriate simple technology and material of the products,

• manufacturing capacities for the supply of large quantities in the required time,

• organisation and international know–how adequate for turnkey production in the project region,

• commercial creditworthiness.

The problem in Europe and other industrialised nations is that prefabricated buildings are manufactured in production lines and the standards of production in most cases are far too high for emergency shelters. Thus new productions must be conceived, requiring time and an appropriate commission volume. In newly industrialising (emerging) countries, production can be cheaper. Large companies in industrialised nations have their contacts there and thus remain interesting competitors. See section 4.7 for more. Having similar contacts, the NGC can also buy these services in emerging countries.

Cooperation with companies from the affected region is always worthwhile as long as their performance capability can be expected, even if justifiable delays have to be reckoned with. A detailed inspection of this issue by experienced personnel of the NGC or the implementing consultant is required here. If applicable, the decision should be agreed upon with the donor/financing agency on the condition that the construction time may be longer, but in return the houses will be cheaper and thus available to a larger number of needy.

(5) Settlement planning and technical services (see also section 4.4)

Settlement planning always has to be implemented in accordance with the local planning authorities. A settlement plan corresponds to an area development plan and is a massive intervention in the existing structure and development of a whole region with long–term consequences. Most of the affected countries dispose of such planning entities. They are in charge of the activities and decisions described under the above mentioned item (1), "Choice of location" and item (2) "Site selection criteria". Most of the planning authorities insist on carrying out the development plan, more or less detailed, themselves. Generally, basic settlement concepts and parameters do exist in a building authority. They often already existed for other purposes before the disaster happened. They will have to serve as orientation, even if these planning concepts were never meant for emergency shelters. Besides, the plans also have to be formally approved by the building authorities. Together with the planning authority and political decision–making bodies, to be appointed by the planning authority, the question of after usage has to be decided on. Here, needy local people or vocational groups of the host country can be named, who will move into the apartments after the departure of the current disaster victims. These considerations will have an influence on the planning of spatial requirements and standards. Decisions have to be made, for example, as to whether or not the beneficiaries are granted a bit of space around their shelter for gardening. It will also be decided, for instance, whether the required development of the settlement can also be used later to build single−family houses, which would ensure the sustainability of at least a part of the investment.

The experts seconded by the NGC can participate in the elaboration of the development plans in different ways. In the interest of an appropriate and quickest possible realisation they ought to decide together with the planning authorities who will take over which planning services. They should also make sure that the space requirement of 45 m^2 per beneficiary, as already mentioned under (1), is fulfilled, they should insist on minimum spacing between the buildings (flash over of fire), ensure that the required social buildings (see also the following item (7) “Social buildings”) are incorporated, and demand sufficient street lighting (sense of security).

They should also intervene when generous planning conceptions threaten to exceed the budget frame. When building several housing settlements, it may be necessary to cooperate with various planning authorities in different provinces. Here it becomes obvious that such development plans take their course and consume time.

If it is not clear where, on which site, and for how many people something shall be built, planning becomes quite difficult. However, there is a possibility to work ahead and save a decisive amount of time. The NGC’s experts should inform the planning authorities and the project executing organisations about the following possible procedures:

(6) Theoretical plan of site and technical services

The NGC, being in charge of financing the required site plan and technical services of the housing settlements and intending to charge a planner with it, commissions the planner in advance with the draft of a so−called “Theoretical plan of site and technical services” (see figure 1). Based on the assumption of a theoretical requirement of land for shelters, roads, social buildings, other open spaces, etc., a theoretical development plan can be developed. It can be assumed, for example, that there will be 2,000 people per settlement and a site area of 45 m^2 per person. Based on this information, the infrastructure planner calculates cable and pipe cross−sections, specifies all other services, and theoretically calculates their quantities.

The tender will be based on these specifications and the commission will be placed. All unit prices and the approximate quantities are now known and the contractor is all set to start. The 4 to 8 weeks, which were needed to search for appropriate sites and draft the final development plans in or together with the building authorities, were profitably used.

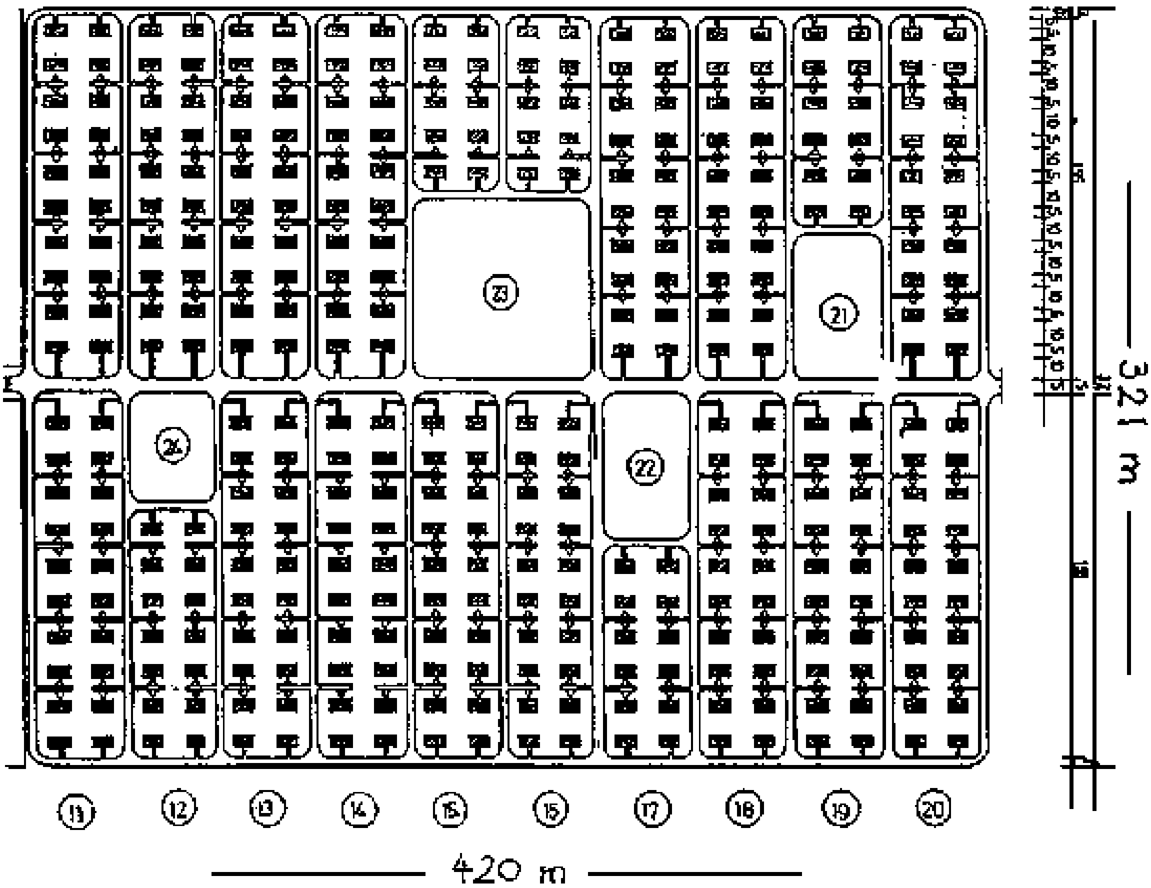


Fig. 1 A theoretical development plan

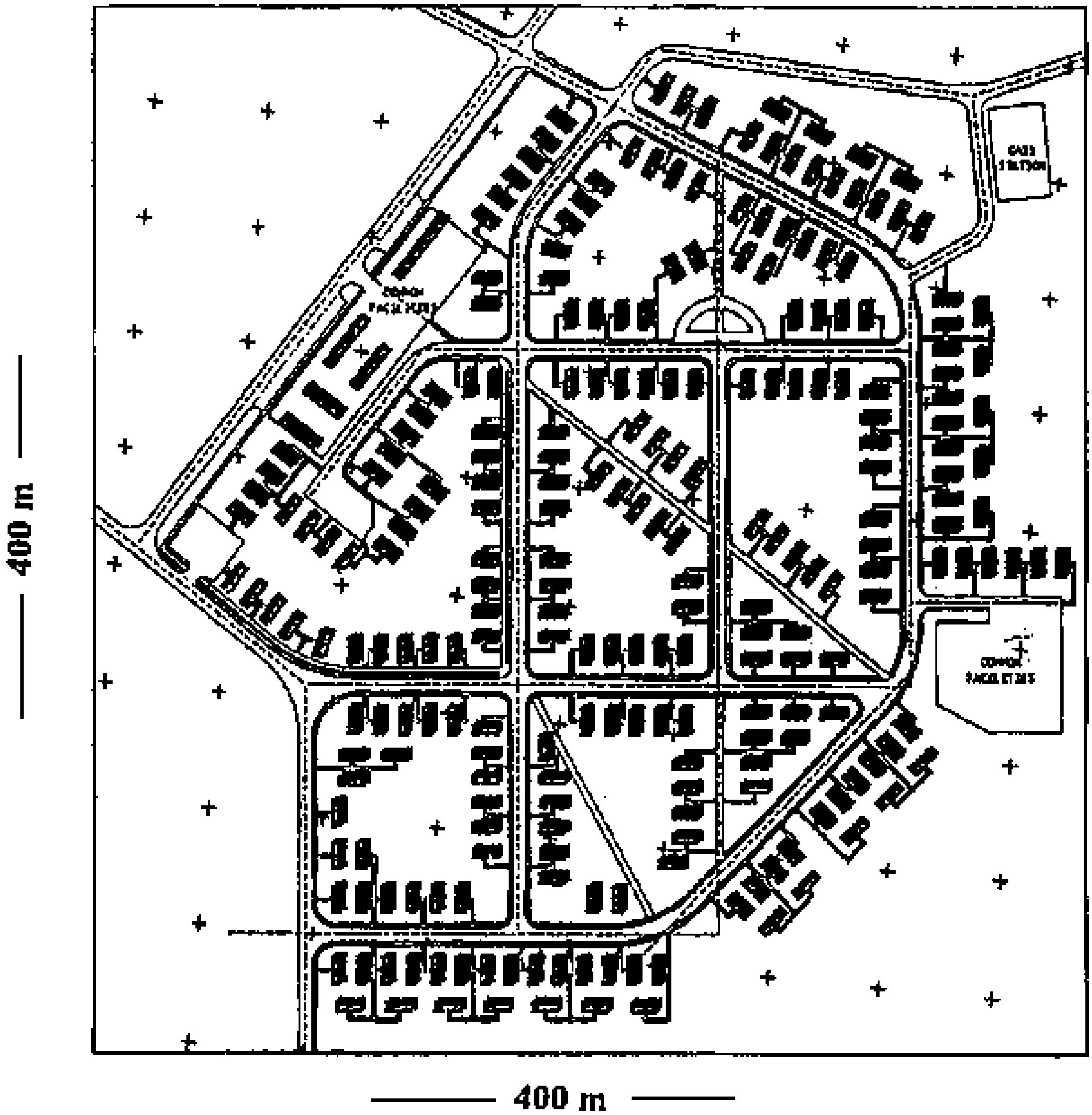


Fig. 2 The actual implementation plan (settlement in Karlovac, Croatia, 1993)

After decisions have been taken on the locations and sites, implementation planning according to the actual sites is carried out simultaneously with the beginning of the contractor's rough earthworks. Further implementation planning is gradually elaborated and handed over to the contractor. Billing is effected according to the actual expenses and dimensions, on the basis of the existing unit prices. Costs for possible new services are negotiated and fixed.

Experience shows that housing settlements of medium standard, erected within the framework of emergency measures in moderate climatic zones, do not, in the course of years, necessarily turn into slums. It is true that inhabitants come and go, but in general they take good care of the buildings. Apartment shortage and demand is too latent in most countries. It also depends on how intensively the local administrations take care of the settlements' operation.

Case study **G**

Refugee settlements, building rehabilitation and extension as humanitarian aid in Croatia

Financing agency:	**Federal Republic of Germany, represented by the Federal Foreign Office (AA)**
Financing volume:	**25,565,000 euros**
Period:	**1992–1993**

Post war period means lost homes, expulsion and flight for a lot of people. In Bosnia and Herzegovina alone, 2.5 million people lost their homes in the war in the Balkans in 1992/1993. About 800,000 had to flee. Hundreds of thousands of people from Bosnia and Croatia moved towards Central Europe.

In the summer of 1992, long before the Dayton Peace Agreement, the government of the Federal Republic of Germany decided, within the framework of humanitarian aid of the Federal Foreign Office (AA), to provide 50 million DM (25,565,000 euros) for the accommodation of approx. 20,000 displaced persons and refugees in winterised shelters in Croatia. Approx. 8,000 persons were to be accommodated in three settlements to be newly erected and approx. 12,000 persons in buildings that were to be rehabilitated or restructured after having been more or less destroyed by war.

At the end of July 1992, the AA appointed GTZ to be General Contractor for the complete project, until then, the largest single project worldwide of the German Humanitarian Aid. GTZ accepted the task without initially knowing where to build, how and for whom.

As a result, scattered over the whole of Croatia, a total of 39 buildings were converted into collective shelters, with sanitary installations, basic furnishings and partly with heating (e.g. 10 hotels, 7 schools, 5 community buildings, 4 hospitals, 2 barracks, 2 old people's homes, 1 factory, 1 museum, 1 orphanage, 1 mineworker's home, 1 youth camp and others more). The cost per refugee amounted to 597 euros, including all incidental expenses and overheads.

In the three settlements to be newly built, with the sites not certain upon commissioning, 8,000 persons were to be accommodated. On the basis of a theoretical building plan of 3 settlements for 2,700 persons each, the building works were tendered and the commissions for 3 different locations were placed. It was only after deciding on locations that the implementation plans of the infrastructure could begin and were pushed ahead simultaneously with the building implementation and gradually realised. The measured quantities of the actually rendered services formed the basis for the calculation and remuneration after completion. This procedure applied to a total area of 51 hectares. An extremely rainy autumn had building vehicles sometimes sink 50 – 70 cm into the topsoil mud of the building sites.

Plans were made with a Croatian general planner. Two Croatian general contractors executed the technical infrastructure. A total of 800 pairs of semi-detached houses with 1,600 housing units, as well as 14 social buildings (schools, kindergartens, health stations, administration buildings) were built by a German-Turkish consortium in turnkey construction using prefabricated, lightweight elements. Each pair of semi-detached houses was provided with a shared bathroom, gas heating (centrally supplied), and basic furniture. In mid-October 1992, building started, with the completion and the moving in of 8,000 refugees being realised in a construction time of 5 months, middle/end of March 1993. The locations of the settlements are Karlovac, near Zagreb, as well as Rokovci and Cepin in Eastern Slavonia. Ten years after completing the three settlements they are all still functioning and have been extended and partly planted with much loving care. A church, as well as additional schools have been built and complete the infrastructure. The serious housing shortage and partly unsolved returning conditions of the refugees to their country of origin make it necessary for these settlements to be retained for the time being.

The costs for the provision of 52,750 m^2 of space for shelters and social facilities amounted to 18.4 million euros. This resulted in expenses of 349 euros/m^2.

For an accommodation of 6 people per housing unit and 5.25 m^2/person, the individual costs, including all incidental expenses and GTZ overheads, amounted to 1,917 euros per refugee.

(7) Social buildings

Independent settlements exceeding a certain size urgently require social buildings, either within the settlement itself or in the neighbourhood. Social buildings are understood as premises for:

- administration,
- kindergarten,
- elementary school,
- health care stations,
- shops for food provision,
- assembly rooms (also to be used as prayer rooms),

or parts of these.

At the beginning of the planning phase the surroundings of the new settlement have to be inspected with regard to them. Social buildings can be very simple structures. On the other hand, the high utilisation frequencies they will be exposed to, have to be taken into consideration. They can be executed with the same technology and construction as the shelters or, in another appropriate form.

Some of the donors/financing agencies and also project executing organisations are not aware of the significance of social buildings in the immediate neighbourhood of the dwellings and disapprove of them, because they are only interested in financing the direct provision of shelter for the needy, i.e. providing a “roof over their heads”. Here, the NGC has to do a lot of convincing, since otherwise considerable problems will inevitably arise. In the planning of the settlements sufficient open spaces have to be incorporated.

Case study **H**

Reconstruction of a school destroyed by earthquake in India

Financing agency:	**Bild Hilft e.V. (“Ein Herz für Kinder”), Hamburg**
Financing volume:	**879,879 Euros**
Period:	**2001 – 2003**

The devastating earthquake of magnitude 7.7 on the Richter scale, having claimed about 30,000 human lives in the West Indian federal state of Gujarat on 26 January 2001 and having almost completely destroyed numerous towns and villages, was one of the worst disasters the region has ever experienced. Luckily the earthquake happened at 08.45 h in the morning and on top of it on “Republic Day”, a national holiday, when most people were outside participating in the celebrations. It is hard to imagine what would have happened if the quake had hit the region at night, when most people would have been in their houses.

The editor–in–chief of the German newspaper “BILD–Zeitung” in Hamburg sent a team of reporters to the disaster region to report on the situation there. At the same time, the aid organisation “Ein Herz für Kinder” (“A heart for children”) published a call for donations in the “BILD–Zeitung”. The fund–raising resulted in more than 1 million euros in donations. As a priority, the money was meant to help children in villages that were most severely hit. During their search, the team of reporters discovered a completely destroyed boarding school for mainly disabled children in Bhachau, a village in the Kutch region, close to the border of Pakistan. Subsequently they decided to use a large part of the donations for the reconstruction of the school.

GTZ was assigned with the implementation of the project. In a limited tender an architectural firm from Ahmedabad was chosen and charged with the design. The tender and awarding of the building works were effected in accordance with the FIDIC guidelines, with a construction company from Chennai being appointed. The Diocese of Rajkot is the project executing agency for the St. Xavier’s High School, Bhachau. After completion, the school will take on up to 800 children, especially from poorer classes of society and disabled children.

The main problems to cope with were the late granting of the building permission, the fear of war in the border region due to the India–Pakistan conflict, the repeated outbreaks of bloody riots between Hindus and Muslims in Gujarat, and the constant price increases. The building costs were considerably above the country’s average, since the highest earthquake resistance was stipulated.

The campus, having the size of about 2 hectares, offers enough space for two school buildings (main building with 20 classes and pre-school with 4 classes), a hostel for 28 girls and 56 boys (a novelty in the region), a house for nuns and female teachers, as well as a house for priests and male teachers. Additionally, large open spaces are provided for sports and games. Assuming a number of 800 pupils, the costs amount to approx. 1,100 euros per pupil, including all incidental costs and GTZ overheads.

Case study **I**

Rehabilitation of schools in flood areas in Cambodia

Financing agency: **Federal Republic of Germany, represented by BMZ**

Financing volume: **375,000 euros**

Period: **2000 – 2001**

Since July 2000, ongoing heavy rainfalls led to inundations of the Mekong and Ton Le Sap in Cambodia. Besides severely damaged houses, roads, and bridges, it also caused the collapse of large parts of the social infrastructure. Health centres, teachers' colleges and schools were especially hit. More than 18% of the schools in the country had to interrupt classes.

BMZ assigned GTZ to support the efforts of the Cambodian Government in reactivating the schools affected by the floods as soon as possible, between December 2000 and March 2001.

One of the first steps was to set up an interim coordination office in the Ministry of Education. The measures were implemented exclusively and at all levels with the staff of the Ministry of Education. In the capital, mainly the departments of planning and real estate were concerned, while at province level coordinators from the province administrations of the ministry were especially appointed, and at district level the school committees comprising parents and teachers were assigned with the task. The project itself was restricted to the provinces of Kandal, Kampot, Kratie, Takeo, Pursat, Kampong Cham, Kampong Chnang, Kep and Koh Kong after reaching an agreement in the Ministry of Education with the other donors. Basically the following tasks were implemented:

- Conclusion of 128 local subsidy contracts with school communities for the creation of 435 new classrooms (including benches and tables) using locally adapted timber construction;

- within the framework of 196 further subsidy contracts, restoration of 1,031 damaged classrooms (including benches and tables);

- distribution of 19,000 boxes of chalk, 490,000 pens, 135,000 black boards, and 111,000 exercise books to all 801 schools affected by the floods in the selected provinces.

In the preliminary stages of the project, the planning department of the Ministry of Education, in cooperation with an expert of UNICEF, had already developed 2 basic types of classrooms, the plans and drafts of which were to serve the school communities as stimulus, but not as condition. On the basis of these plans, the department of real estate drew up a menu of materials that can be supplied locally and fixed their local prices. Out of this menu the school communities could select an assortment of materials at a price of up to 300 US $ for the erection of a classroom for 40 pupils. A similar list had been prepared for repair works, the maximum rate being 300 US $ (but including 15% expense allowance as substitute for WFP−food rations). The building and equipment measures amounted to a total of 375,000 euros, including the GTZ overheads.

It is assumed that a total of about 60,000 pupils have taken benefit from the building and repair measures. Thus for each pupil an amount of approx. 6 euros was invested, including the expenses for the supply of teaching materials, schoolbooks and equipment, as well as all overheads.

Furthermore, the coordination office mobilised food supplies, via the WFP, worth approx. 45,000 euros, for the 128 school communities that erected new school rooms. The establishment of the coordination office itself led to the immediate provision of a further 402,860 US $ by OCHA, SIDA and the Polish embassy for similar measures in other provinces.

5.2 Self−help models

5.2.1 General

Self−help models contain a range of possibilities of transferring knowledge and new building techniques to the target group, especially in the field of disaster−resistant building. Furthermore, they strengthen the target group's organisational potential and favour the early formation of neighbour relationships and communal spirit. The improved opportunity of participating in decision−making creates acceptance for the project and widely ensures an implementation that meets the demand. The weighting of the share of personal contributions towards external promotion influences conflict−related impacts of the building measure. A combination of self−help and contractor models in respective sections is also possible.

Compared to contractor models, self−help models generally lead to a prolongation of the building measure. In most cases, the costs of the whole project do not decrease, since considerable consulting and training components are required.

Building is a technical discipline requiring planning, engineering expertise, and manual skills, even when dealing with repairs of supposedly simple buildings and shelters. By far not all people affected by natural disasters or war−induced destructions are technically and physically in the position to repair their buildings in self−help or to reconstruct them in a different location. The opposite is often the case. The fight for survival, i.e. food provision, health care, care of families and the elderly, commits their forces, so that the affected are not even available for minor works. In war situations, many households are run by women on a temporary or long−term basis, since the men might still be in military service or may have died.

In general, self−help to provide shelter for the family can only be realised with one's own house or apartment. In situations where people have fled or have been displaced, self−help is only rarely possible, as their stay is only temporary with the aim of returning to their home country. This is especially true for complex building measures in moderate climates and relatively developed zones requiring high investments and a long−term securing of property.

As long as the households do not give up any other income generating employment, which would further worsen their economic situation caused by the emergency situation, self−help models present possible solutions. In societies marked by agricultural self−sufficiency the cultivation of basic foodstuffs must not be affected by the participation in construction measures. In principle, refugees or displaced persons (generally men) can apply as skilled or unskilled workers to the construction companies in charge of building shelters. However, chances are limited here, too, as companies first employ their own workers, who they know well.

In the context of self−help issues, not only the directly affected local population and the refugees have to be considered, but also the countries' production forces as a whole. The services of the project executing organisation, the political decision−making bodies, and, last but not least, the companies and people of the local construction industry contribute considerably, even if local planners and construction companies, for example, are paid from the donors' funds and benefit financially. These earnings immediately flow back into the circulation and foster the economic development of the affected country.

However, there are situations and regions where self−help is perfectly appropriate and works well. In these situations, knowledge about improved building techniques can be transmitted (see also chapter 6). In the following, different self−help models are described, showing the implementation of reconstruction measures by personal contributions of the affected persons (disaster victims, refugees, displaced persons) with financial and technical support from national and international organisations. The nature and scope of the support and the technical advice through the project executing organisation (local authority) and the NGC, differ according to the type of the self−help model. Several types and combinations exist, resulting from the specific requirements on location.

5.2.2 Methodological approach

The methodological approach basically corresponds to the contractor models. Here, too,

1. the donor/financing agency defines its intended support, thus

2. enabling an expert group of the NGC to perform a situation analysis and a rapid assessment, which

3. result in an offer of the NGC, which incorporates an operational or implementation proposal. After

4. the commissioning of the NGC by the financing agency,

5. an implementation agreement is to be concluded between the NGC and the project executing organisation before

6. the implementation of the reconstruction measures can begin. Upon completion,

7. the acceptance procedures, handing−over, and, if necessary, aftercare take place.

The difference, however, lies in the fact that the target group is involved more intensively in the planning and implementation of the building works, and building contracts with contractors are concluded at best for partial works. It all depends on the type of self−help described in the following sections.

5.2.3 Aided individual family self−help

This concerns the reconstruction of damaged apartments or houses of individual families, which dispose of the required labour, but only of a limited amount of the required financial means and/or technical knowledge. Provided that they meet the conditions for support (see below: (1) Criteria for the eligibility for promotion) they are generally advised by the NGC or project executing organisation about the building measures to be implemented, especially with regard to:

- nature and scope of support,
- nature and scope of services to be provided,
- technical explanations of the building measures,
- procedure and duration of the measure,
- financing opportunities (subsidy, loan).

The scope of support and supply of building material is determined by a specification and bill of quantities drawn up beforehand by a local construction expert, contracted by the NGC, and only comprises those measures offering a minimum amount of living comfort (protection against cold, heat, rain, wind; inclusion of light and air; privacy), hygiene (minimum provision of washing facilities and toilet) and security (against destruction by natural disasters, against intruders, etc.). A time frame – as realistically estimated as possible – is given for this. All completion and extension works that go beyond this are to be carried out later by the families themselves at their own responsibility.

(1) Criteria of eligibility for promotion

- Proof has to be given that the family is the owner of the damaged house or damaged apartment.

- The family income has to be below a certain income level (defined by the local authorities).

- The family has to agree to contribute a minimum personal input to the reconstruction works (to be determined according to the project concept). Some special works (e.g. carpentry, sanitary, electrical works) can, if necessary, be contracted to professionals and special companies, which may also be appointed by the NGC or the executing organisation.

- They have to commit themselves to follow the instructions of the construction expert (or foreman) and to finish the works within the given period of time.

In case an appraisal of the project executing organisation reveals that it is qualified for the implementation of this service, it receives the required funds via a Financing Agreement from the NGC. Should the project executing organisation not be qualified, the NGC will take over these services.

(2) Tasks of the local project executing organisation

(2) Tasks of the local project executing organisation (municipality, building authority, coordination office for disaster aid measures):

- Drawing up of lists of beneficiaries.

- Appraisal of neediness as well as the beneficiaries' ability to provide self–help.

- Involving the target families in the planning of the construction measures.

- Selecting, contracting, and introducing local construction experts to appraise the construction damage and assess the required reconstruction measures.

- Instruction of the construction expert.

- Conclusion of the agreement with the beneficiaries on the implementation of self–help measures.

- Ordering the planning of the project (with special regard to structural security) as well as calculation of the material requirements.

- Procuring, storing, and distributing the required building material.

- Monitoring and overall supervision of the project procedures.

- Commercial controlling, i.e. for instance, settling accounts, keeping watch on the costs and budget.

(3) Tasks of the NGC

• Conclusion of the project agreement with the project executing organisation.

• Advising the local partners on the procedures when fixing criteria for the eligibility for promotion of beneficiaries, when drafting agreements with the beneficiaries, etc.

• Reporting to the financing agency.

5.2.4 Aided community self-help in housing construction

In order to be able to increase the self-help efficiency, several families (3 to 5) can join together and form a neighbourhood cooperation and repair or reconstruct their damaged apartments or houses by a joint building team consisting of members of affected families. The promotion criteria and the promotion procedure are basically the same as those of the aided individual family self-help. In this case, however, families are committed jointly.

Case study **J**

Aid for earthquake victims in Colombia

Financing agency:	**Federal Republic of Germany represented by BMZ**
Financing volume:	**1,073,700 euros**
Period:	**1999–2000**

On 25 January 1999 an earthquake of magnitude 6 on the Richter scale hit Columbia's coffee region. More than 200,000 people became homeless in the region around the city of Armenia. After the distribution of food and medicine and the provision of simple sanitary facilities in temporary shelters in the first days after the earthquake, the reconstruction of houses in different communities of the Department of Quindio, especially for the population groups of poor, landless coffee pickers, was identified as priority measure in the ongoing process. In the weeks to follow, 278 houses were built out of bamboo in several communities.

During the building conception, in cooperation with the University of Pereira, a new house type using locally grown bamboo had been developed, offering a higher resistance to earthquakes due to the special frame construction. The communities supported the building measure through the administration of material stocks and the mobilisation of the target group, while the coffee plantation owners provided material for the foundations as well as machines. The training of the target group further enabled a great share of self-help contribution and future income opportunities for trained people in the building sector, who benefited directly due to the great acceptance of the model. Even though the building measure was delayed as a result of the numerous economic problems of the households in providing at least one worker each, the first house was completed after 70 days. The low building costs due to the use of local material and the culturally adapted construction method led to the fact that the model was adopted by other aid organisations, still during the construction phase, and was also copied locally.

A total of 1,540 earthquake victims were accommodated in the 278 houses with the help of the reconstruction measures. Applying a mixed calculation results in accommodation costs of 697 euros per person, taking into consideration all emergency and accompanying measures, incidental expenses, and GTZ overheads.

The project is considered a successful example of development-oriented emergency aid, since on the one hand the project provided shelter for the victims, and, on the other hand, an innovative, adapted, and inexpensive building technique with a considerable multiplying effect had been successfully introduced. The efficient cooperation between the target group, communities, the association of coffee growers, and the University of Pereira contributed decisively to its success. Despite the heavy rainfalls during the building phase and delay in the provision of sites in areas less endangered by earthquakes, the earthquake victims were not provided with just emergency shelter, but instead with permanent accommodations within a reasonable period of time. This resulted in a boosting of the affected people's self-confidence in a great emergency situation.

Case study **K**

Support measures for the homeless in Freetown, Sierra Leone

Financing agency: **Federal Republic of Germany, represented by BMZ**

Financing volume: **690,700 euros**

Period: **1999**

In January 1999, approx. 50,000 people in the eastern part of the capital of Freetown became homeless as a result of the fighting during the civil war in Sierra Leone. They had to find refuge within a short time in other parts of the city, which, however, could not absorb the crowds streaming in.

The reconstruction measures were executed by self-help or neighbourhood cooperation. The population was mobilised by the local reconstruction committees, which had also supported the assessment of damage before. Within the project, workshops were set up, where local craftsmen, having lost most of their tools during the civil war, manufactured doors and windows and received a basic set of tools as compensation after completion of the measure. The workshop operations were continued by the local people themselves after the building project was over. The work groups, organised by the neighbourhoods, built raw structures up to roof level in traditional earth construction. The plaster, a concrete floor, as well as roof substructure and covering were subsequently executed by local craftsmen. A local NGO coordinated and advised the reconstruction committees. In various sectors of the city, decentralised building yards for storing building materials, some of which being recovered from the ruins, were set up and run by the reconstruction committees. In the rainy season, tarpaulin sheds covered the building yards, which enabled the manufacturing of concrete blocks, even during the rains.

GTZ's contribution in addition to providing material support focused on the damage assessment and the participatory selection of building projects to be promoted. Afterwards, mainly organisational support and consultation of the reconstruction committee as well as the contracted NGOs were rendered.

Between May and December 1999, shelters for 1,800 families (approx. 10,500 people), as well as 12 schools for 5,000 pupils, a health care centre, and a maternity clinic were set up within the framework of the project. The costs of the project measures carried out by GTZ amounted to 690,700 euros. Including the costs of the community buildings, incidental costs, and GTZ overheads, this results in accommodation costs of 66 euros per person. Part of the building material (corrugated iron, building timber, cement), as well as foodstuffs for "Food for Work" measures were provided by CARE, CRS and UNDP/UNOPS and are not included in the accommodation costs.

The project is to be considered especially successful since a contribution to ease the crisis situation in the capital could be made with little effort but high personal contributions. Additionally, the local building industry was given the chance of a new beginning. The efficient and smooth cooperation between the different aid organisations enabled a rapid and in all cost efficient realisation of the project. The good cooperation with the authorities as well enabled a quick resumption of school and health care services. Furthermore, the reconstruction committee's ability to organise and act was strengthened and is still being used for other tasks.

In general, the aim is to unite families into one group within a neighbourhood, in order to strengthen the community spirit and to keep distances short. The nature of construction works on apartments or houses should also be similar, in order to ensure that the work to be done is more or less the same for each family. In order to make sure that families, whose houses are completed first, do not reduce their share of participation in the community self−help scheme, or even back out entirely, it is important that the work procedures be organised such that all accommodations are completed simultaneously. Therefore, for example, all foundations should be produced successively, followed by all masonry works, installation of windows and doors, all plastering works, all paintworks, etc. This enjoys the additional advantage of greater efficiency in work performance, as well as a more effective use of equipment and materials.

The local project executing organisation's task here is to provide support and supervise the works through a building expert, as well as to procure, store, and distribute the required material. In case a Financing Agreement is not possible, the NGC advises the project executing organisation and, above all, takes over the commercial controlling.

5.2.5 Aided community self−help in the construction of community facilities

Aided community self−help has also proved to be successful in the field of rehabilitation and reconstruction of buildings of social infrastructure, e.g. schools. Here, the procedures can be as follows:

• The construction department of the school authority or the building authority, possibly in cooperation with private architects and engineers, takes over responsibility for planning, calculation, material lists, site supervision, and approval.

• Each school forms a school development society, consisting of teachers and parents, who determine the conception of the measures and provide personal inputs in the form of material supply, manual work, and, if necessary, financial contributions. Experience has shown that these personal contributions constitute between 10% and 30% of the total building costs. The balance is covered by the NGC. The school development society assumes the role of the client and concludes contracts with craftsmen, advised by the school authority's construction department or the building authority, which also determines the craftsmen's wages and sets upper limits for other costs. Those costs are fixed at market rates. Should resources become scarce during implementation, some of the works will have to be cancelled. In case the school development society has worked economically and financial means remain, it can additionally invest these in construction or in other pending school projects.

• The NGC concludes an agreement with each school development society, procures the building material free on site, takes care of the administrative, commercial, and technical supervision, and finances the measures. The NGC also finances the private architects and engineers, who support the building authority or the building department of the school authority.

The model can also be applied to community centres and other small measures, e.g. school furniture, toilet construction. The procedures are generally the same as described above.

5.2.6 Other self−help models

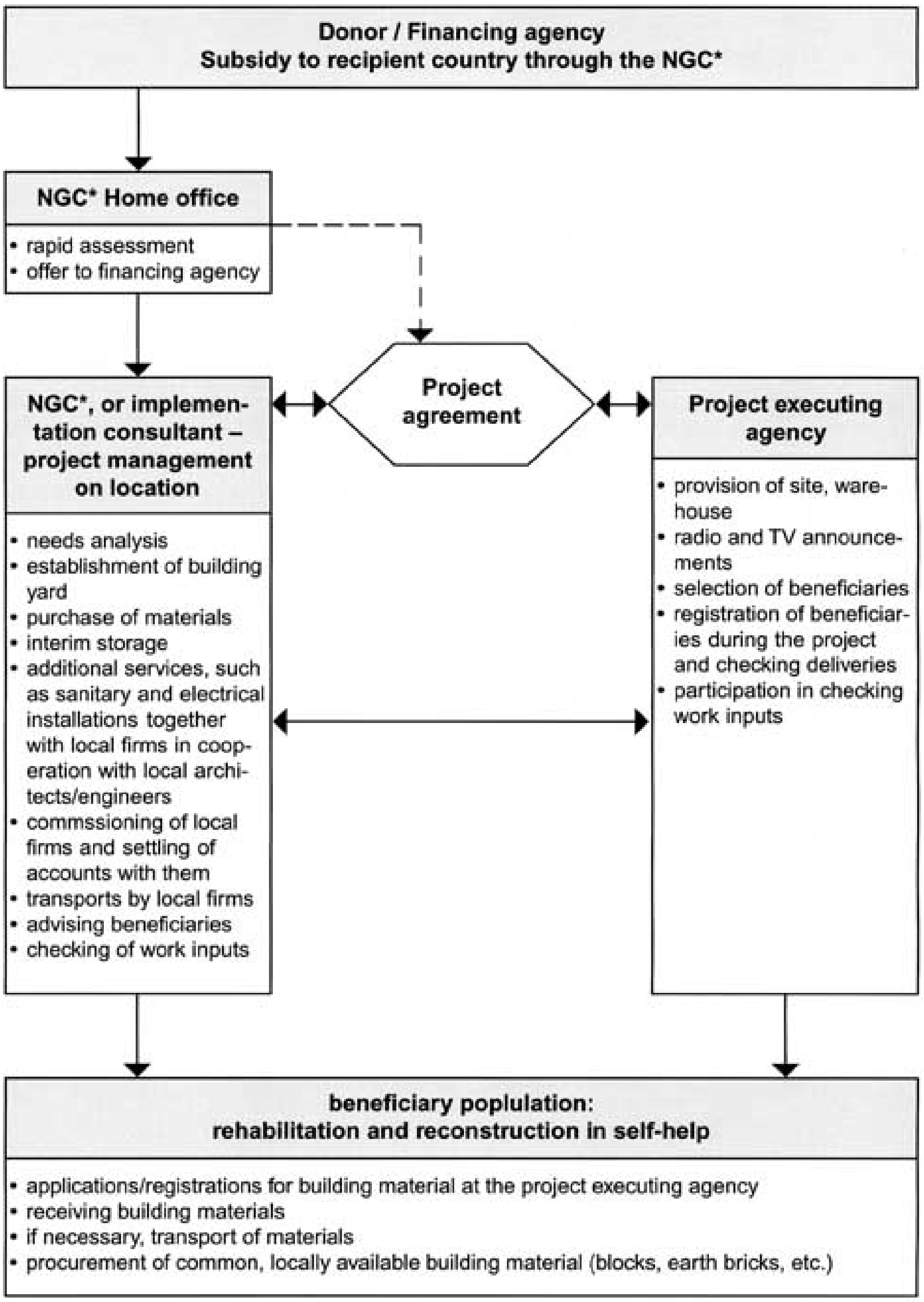
A rarer version of the self−help model is the building of new houses on new sites. This occurs when the authorities provide land for the beneficiaries to build on by themselves. Architects and engineers draw up the plans of settlements and the house types, on commission by the local executing organisation. The site development as well is carried out by specialist companies, while the actual building of the house is left to the settlers. The NGC procures the building material free on site, takes care of the administrative, commercial, and technical supervision and finances the measures. The services of all parties involved have to be settled by contract.

For the individual families it is almost impossible to build their own house without help from outside. Together with other families, however, the house can be built rapidly and efficiently. In this case, the community self−help described above, which incorporates technical assistance by a local building expert, is an ideal implementation model. Here it is also important to complete the individual houses of a neighbourhood building team almost simultaneously. In order to make sure that all buildings are completed in the same standard and that none of the involved families is privileged in the allocation of houses, these are assigned after completion of all building works by casting lots.

The nucleus model for rehabilitating private houses is a special form of self−help, which occurs after the core ("nucleus") of the beneficiary's house is constructed as a stimulus by a building company, commissioned by the executing organisation according to the NGC's instructions. Usually, this nucleus consists of one living room with a roof, windows and doors, as well as the most important sanitary facilities and energy supply. The beneficiary family completes the building. This model is described in section 5.1.5.2 (3).

The building yard model described under 5.3 is a special form of all models mentioned before. It envisages the establishment of a large warehouse for building material (sometimes technical equipment as well) and has proved successful in situations when building material is rarely available or only at excessive prices on the open market. By bulk purchases and import of building material and equipment through foreign aid organisations, people intending to build can purchase the material considerably cheaper. The building yards dispose of specialised personnel offering advice and help to potential builders. In some cases, the building yards have sample houses on display and also offer training courses.

5.3 Building yard model



* NGC = non−commercial general contractor

5.3 Building yard model

(1) Aim of the model

There are several so−called building yard models for the coverage of material requirements and reconstruction after disasters satisfying varying requirements. The purpose and philosophy of the building yard model described here is to support the needy native population in rural regions and in the suburban areas in the reconstruction of their destroyed houses and apartments after natural disasters or impacts of war.

First of all, it is a matter of providing a minimum of essential basic building material as fast as possible to give the people at least a simple “roof over their heads” or to “winterise” their partly destroyed houses. The works are mainly executed by personal labour inputs of the affected family or by neighbourhood cooperation. The individual building concept has to be oriented towards the skills of the affected people, which normally means only simple repair works.

This model can also be applied for the new construction of simple dwelling houses.

(2) Project executing organisation and beneficiaries

Even for the concept of a building yard model, a written project agreement has to be concluded with the local project executing agency, listing the rights and obligations of both parties. Assisting services of the executing agency could be the provision of a site free of charge and a warehouse or industrial hall as building yard store, saving the financing agency some money. The funds saved would be available for additional supply of material.

The choice of beneficiaries who should receive building material and support has to be made either by the executing organisation or someone appointed by them. This cannot be a duty of the building yard management. They should, however, be involved in the determination of the selection criteria as well as observe the operations and report supposed and major irregularities to the financing agency through the NGC.

The project executing organisation has to inform the population, for example, via radio, television or a notice at the community authorities, about the supporting measures and conduct or delegate the registration, while maintaining full responsibility. Furthermore, it also has to assign personnel, which later on, during the distribution of building material and provision of other services, has to get the beneficiaries' confirmation of receipt of the goods or services. This personnel becomes a part of the building yard team and also has an office there.

(3) Building material

What is to be understood by basic building material depends on the situation in the country, the degree of destruction of the houses and the common material and technologies of the particular country. This is to be investigated in advance. In the beginning, it mainly concerns roof−covering material (possibly temporary covering), bricks, lime and cement, construction timber and reinforced plastic sheets for the temporary closing of window openings. Since in most cases the material resources in the affected countries run out fast, the building material is specified by the NGC and, after invitation of tenders, obtained from bordering countries or other regions, and then temporarily stored in the building yard. Here, experienced purchasing agents of the NGC with international experience are required. Amongst others, the following tasks are involved:

- Procurement of building material (invitation of tenders, purchase, cost management, accounts, organisational control, i.e. observation of delivery and payment delays);

- Organisation, implementation, monitoring (personnel and material) and accounting of transportation.

It is worth considering providing material allotments, so−called "material kits", of equal size per family/household, in order to maintain equality and ensure that no envy arises. Occasionally, larger allotments may be supplied, provided that it concerns larger families and greater destruction. A transparent management of the allotments is essential.

It is a declared aim of the relief actions not to create business competition with the country's building material suppliers, as far as such traders exist and are sure to supply the required quantity fast and at fair prices. With increasing alleviation of the most urgent needs, the building yard's function is gradually reduced.

In the course of the situation analysis or rapid assessment, when the establishment of a building yard becomes apparent, a first rough list of material required and cost estimate have to be drawn up by the appraiser after an estimated damage analysis. This cost estimate is a constituent for the formulation of the budget and offer to the donor/financing agency.

(4) Extended scope of services

Supplementary to the basic building material, the provision of simple house installations, e.g. electrical installations and sanitary units can also be included in the programme of the building yard, as far as this standard is found essential and cannot be provided by the target group. The building yard's management, however, will not procure and store installation units of its own, but will cooperate with the local building industry (installation companies) and subcontract these services completely to them. The advantage is that the standards and materials applied are those common on the local market, and can easily be repaired or augmented later on. One or more local engineers or an engineering office should be employed by the NGC to carry out investigations on the partly destroyed houses and to formulate the specifications and description of services, on the basis of which the local installation companies can submit their offers.

The disadvantage of taking over such extended services is that the building yard management neither has an influence, nor wants to exert it on the performance of personal contributions of the house owners, and thus the interfaces between the services of the installation companies and those of the self–help groups are hard to coordinate. Significant delays and possible material losses can occur. It is, however, the declared goal of the NGC not to assume the role of a contractor in the building yard model, who is in charge of the completion of the houses and is judged accordingly. The NGC supplies and distributes building material and supports the beneficiaries, if necessary also with the help of installation companies that are contracted, whose services are checked and then paid. The coordination and completion, however, lies in the hands of the house owners. In case serious problems arise within these extended services, they should be called off. For such cases there are other models, presented as contractor models in the above section 5.1.5.2 “Rehabilitation of houses destroyed by war”, for which the NGC takes over total responsibility.

Provided the market does not already offer these products, an extension of the scope of services can be, for example, the import and distribution of simple small windows and doors, preferably in wooden constructions, adapted to the country's standard. Furthermore, standardised, insulated lightweight roofing elements in the form of panels can be imported to replace the destroyed traditional roof constructions made of wood and mud, for example in arid rural zones. The house owners themselves can install them.

Another viable option is the import of large quantities of seasoned sawn timber for the construction of windows and doors on location in the affected country, in case there is a shortage (for example, in Afghanistan). This way, the manufacture of complete windows and doors could be arranged with local carpenters upon provision of sawn timber, which would then be distributed by the building yard.

(5) Technical prerequisite of the building yard

Depending on the estimated budget an appropriate building or rather a warehouse should be made available, if not provided free of charge by the project executing organisation, then on a rental basis by the building yard management. Possibly a partly destroyed hall can be repaired for this purpose. The site must have a connection to the public road networks, suitable for heavy vehicles. The site has to be lockable (fence). In case no hall is available, a roofed area has to be built for material requiring protection. Office space has to be provided for the building yard management. The building has to have or receive power connections, including three phase supply (380 V). The establishment of workshops or the acquiring of special machines and vehicles (other than a forklift) is not required. These are to be rented, if necessary.

(6) Building material distribution

The distribution of building material is one of the most difficult work steps. It should first of all be ensured that the material procured by the NGC from within the country or neighbouring countries, as well as that imported from overseas, will be supplied free on building yard and stored there.

Case study **L**

Rehabilitation of schools and housing for returning refugees in Jaffna, Sri Lanka

Financing agency:	**Federal Republic of Germany represented by BMZ within the framework of TC and the KfW within the framework of commodity aid**
Financing volume:	**3,683,700 euros**
Period:	**1996–2003**

Since 1983 Sri Lanka has been marked by ethnic conflicts, which led to a civil war still ongoing in spring 2002. In April 2002 a cease−fire was declared and negotiations are being held since. In the whole country, approx. 530,000 families, mainly Tamils, were forced to flee. The war between the Sri Lankan army and the Tamil rebel group LTTE (Liberation Tigers of Tamil Eelam) in the Jaffna district, had led to considerable destruction of infrastructure and to the flight of almost half of the population of the Jaffna province during the years 1995/96. Until spring 2002 it was reduced to 450,000 people.

Already at the end of 1996, BMZ decided to support the government of Sri Lanka in the reconstruction of Jaffna and the repatriation of refugees, and charged GTZ with the implementation. The “Jaffna Rehabilitation Project” (JRP) was created. The KfW granted financial aid in the form of so−called commodity aid, which was carried out by GTZ. The “Resettlement and Rehabilitation Authority of the North” (RRAN) is the counterpart institution in coordination with the “Government Agent” (GA).

The main activities of JRP are:

- rehabilitation of the drinking−water supply in the city of Jaffa and the whole region,
- rehabilitation or reconstruction and furnishing of schools,
- reconstruction of houses,
- operation of a central building yard for the supply and distribution of material,
- promotion of small enterprises (production of micro−concrete roof tiles).

The central building yard is the project’s coordination point. The housing construction is generally carried out by the families themselves, the construction or rehabilitation of schools by so−called “School Development Societies” (SDS), i.e. teacher−parents−interest groups. The building yard provides the building material, which is mainly procured from Colombo.

Building experts of the “School Works Branch” (Department of Construction of the Ministry of Education) control and advise on construction−related issues with the support of private architects. The GTZ experts advise and coordinate.

At the end of 2002 the project implementation still continued. It will end in 2003. Until now the following building works were implemented:

• rehabilitation of buildings and reconstruction of a total of 24 schools	1,063,400	euros
• supply of furniture for a total of 24 schools	63,900	euros
• construction of school toilets for a total of 230 schools	814,700	euros
• erection of 1,000 housing units	1,677,000	euros
• setting up and operation of 1 central building yard	64,700	euros
The total costs for all building construction measures so far amount to	3,683,700	euros

The aim should be to have the beneficiaries pick up the building material, which is generally provided free of charge, at the building yard and thus have them arrange for the transport by themselves and at their own expense. In the building yard it will be registered and confirmed by the recipient which family from which village has received what kind of material for which house. These registrations and confirmations are incumbent upon the local administration or project executing organisation (also refer to item (2)).

If, after a thorough appraisal through representatives of the project executing organisation, it can be confirmed that beneficiaries are not in the position to organise and pay for the transport, then the building yard management can be charged with it. For that purpose, cooperation with local transport companies should be arranged. Together with them, a system of loading schedule, distribution, and confirmation of receipt should be elaborated, according to which distribution and billing is effected on behalf and at the expense of the NGC. This system requires the executing organisation to be included in the control and confirmation. Building up their own fleet of vehicles is only necessary when the market does not offer this service, which should rarely be the case. In general, it is uneconomic to have one’s own vehicle fleet, as it is inflexible in usage, expensive to operate, and is difficult to manage with regard to repair works and spare parts. Just a small lorry should be available for special requirements.

(7) The building yard team

Personnel (example):

The quantity and quality of personnel depends on the concept and nature of service to be provided by the building yard. It influences the decision as to which personnel is to be seconded or whether qualified personnel can be recruited on location. Should the NGC, for example, already dispose of an office there, then this can possibly take over various functions (e.g. commercial activities, secretarial work, and the like). Consequently the personnel is to be composed individually. Required are:

- 1 building yard manager (technical background);
- 1 assistant manager (as deputy) (technical or commercial background);
- 2 local persons (building technology experts) for the management of the “extended services”, in accordance with the above section 5.3 (4); person(s), who can also be allocated by a local engineering office;
- 1−2 interpreters, depending on the local technicians’ language knowledge;
- 1 forklift driver (if required);
- 2−3 drivers (for cars and for small lorries);
- 10 − 20 warehouse workers;
- at least 2 local counterparts, in charge of tasks such as those described in section 5.3 (2), “Project executing organisation and beneficiaries”.

Equipment (example):

- office equipment, as far as possible incl. computers, e−mail, telephone and fax machine;
- satellite telephone, if required;
- 2 − 3 cars, if possible all−terrain vehicles;
- 1 small lorry, approx. 3−5 tonnes (if required);
- 1 forklift (if required);
- general tools for warehouse workers.

Costs for accommodation and expenses.

5.4 Special projects

GTZ is one of the largest public service companies worldwide in the field of development cooperation, disposing of decades of experience. With the help of its qualified staff, which is familiar with the social, economic, political, and cultural conditions of its partner countries, it is in the position to execute complex special projects concerning many sectors, for national authorities, and international clients and institutions. The support of the Emergency Loya Jirga in Kabul, Afghanistan, which took place from 11 to 19 June 2002, will be presented in the following case study.

Case study **M**

Support of the Emergency Loya Jirga in Kabul, Afghanistan, from 11 to 19 June 2002

Financing agency: **UNDP (United Nations Development Programme)**

Financing volume: **8,100,000 US $**

Period: **2002**

At the beginning of April 2002, GTZ received a commission from UNDP to technically renew the buildings of the partly destroyed technical college in Kabul as well as the 33.6 ha large site on which it is situated, in the extremely short period of time until 10 June 2002 (10 weeks), to conduct the elections of the head of state and the most important members of the Afghan interim government, and to ensure the organisation of the event. A total of 1,685 delegates, among them approx. 185 women and 1,676 persons for service, organisation and security, were to be accommodated on the site (delegates in the buildings, personnel partly in tents).

The implementation of the works was performed in close cooperation with the Afghan Loya Jirga Commission, UNAMA (United Nations Assistance Mission for Afghanistan), ISAF (International Security Assistance Force) concerning security aspects and a number of Afghan, German and international companies for the construction works and the organisation of the conference.

In addition to the logistic requirements (e.g. conference technology, information and communication, security, registration, catering, equipment and accommodation, supply, transportation and health care) and the conference management (e.g. care of the participants, questions concerning protocol, press and public relations, information and communication, recruiting and training of personnel), the building works for a temporary restoration of the existing buildings and the creating of a new, separate conference area (conference tent of 2,800 m^2 and various tents for meetings, VIPs and conference management) and a temporary technical infrastructure (water supply, 200 toilets, 3,000 m illuminated security fences equipped with watch towers, supply of electricity and complete lighting of the buildings and the site) constituted the outstanding services. A total of 5 Antonov freight planes brought, for example, conference tents and conference equipment from Germany.

All in all, 27,480 m^2 of building area were rehabilitated for temporary use (hostels, dining hall, multipurpose hall, service buildings) and a temporary traditional large kitchen of 1,000 m^2, with a capacity of approx. 9,000 meals per day, was set up. In addition to that, 14 temporary structures with toilet and washing facilities having a total area of 2,240 m^2 were set up, and the outdoor areas, such as roads, paths and gardens, were prepared.

On 8 June 2002, the completed facilities were punctually handed over to the Afghan Loya Jirga Commission.

6. Basic planning criteria for simple buildings worldwide

6.1 General

The construction of buildings within disaster relief measures does not differ from building in normal situations, as long as these are not temporary buildings and emergency accommodations. The planning and realisation of dwellings must always take the following factors into consideration:

- Economic aspects
- Socio–cultural aspects
- Ecological aspects
- The climatic conditions
- Protective measures against natural hazards

Taking all the factors into consideration can in some cases lead to contradicting planning requirements. This is particularly true in the case of emergency housing, which calls for compromises on account of time and cost restraints.

6.2 Economic aspects

The need to restore living space is usually high when the number of people rendered homeless due to expulsion or destruction of houses is high. In general, the greater part of reconstruction of living space is carried out by the affected people themselves with their own resources and in self–help, partly supported by grants and special credit programmes on a national level.

The provision of housing within the framework of technical cooperation constitutes a relatively large individual promotion on account of the high cost per beneficiary. That is why such aid can generally reach only a small number of the needy.

The key indicator for the cost efficiency of building measures is the resulting cost per accommodated family or person. The costs of building measures vary considerably on a global scale, on the one hand due to the method of construction, but also due to the extreme variations in the costs of building materials, transports, wages and other influencing factors, e.g. political ones.

Apart from the cost effectiveness in the narrower sense, the economic analysis must also consider other economic benefits of the affected population: these include the reduction of risk of destruction of dwelling space due to disaster resistant constructions in future local projects, or even the model effect for future building technologies in the country as a whole. In the process, the building costs may increase only marginally, while the costs of transferring of new technologies, knowledge and skills also have to be taken into account. Moreover, it is important to conduct a comparative evaluation of the long term economic advantages for the present and future users of buildings with normal life spans compared to temporarily used buildings.

It is possible to influence the costs through the choice of models: it cannot be assumed that self–help models are principally more economic than contractor models, because a higher degree of support and longer duration of self–help projects have to be taken into account. When especially needy groups are being supported, it is usually not possible to expect personal inputs from them which will significantly reduce the total construction costs.

In order to serve as large a number of people in need of housing as economically as possible, the rehabilitation of living space in private houses or in hotels offer particularly suitable alternatives, as the costs are generally lower than those of new constructions. When rehabilitating private houses, the economic benefit is also distributed amongst the host population, in the case of public buildings the host communities get the benefit.

The nucleus model can lead to a reduction of costs per user, because within a short time only the most important building parts are constructed, and the rest of the building works is carried out without external assistance. The building yard model can also be comparatively cost–efficient, depending on its application, as it mainly deals with material aid.

Temporary shelter is usually cheaper and quicker to produce, but of less advantage with regard to the local economic development and sustainability. The cost benefit, however, is limited by the fact that mainly external resources have to be used (import of prefabricated building components and production by international construction companies).

The establishment of new housing settlements is generally cost intensive and constitutes a severe intervention, which is economically justified only in cases where the utilisation of safer sites leads to a significant reduction of disaster risk.

In general the cost effectiveness of a model has to be weighed against several other factors, and the feasibility of each model has to be ensured under the special emergency conditions and in the specific local context, otherwise the ultimate success of the project will be at stake.

Apart from the choice of models of implementation, the planning criteria for simple buildings can each be analysed in terms of cost considerations. It would be ideal to apply as many as possible of the criteria listed in this chapter when designing buildings, but since the financial means are usually very limited, the costs incurred rarely permit the application of all the required measures. That is why the application of economical construction methods is of particular importance. The costs can usually be reduced by the following aspects:

• Utilisation of locally proven building materials and technologies (Local building traditions are usually the most economical; they use abundantly available and inexpensive building materials, which can be supplied without delay; they utilise common local handicrafts and materials available on the local market, and thus ensure easy repairs and repetitions at relatively low cost).

• Building without heavy equipment (While a high degree of mechanisation of building measures is common in industrialised countries and generally more cost effective, in poorer countries it is often not possible and considerably more expensive than manpower; moreover breakdowns can occur, causing expensive and lengthy repairs, and problems can arise during transports).

• Design concepts using lightweight building elements (They simplify transports and assembly, and are therefore cheaper and more easy to realise in remote locations).

• Economical building design (Simple compact forms reduce the ratio of wall surface to usable floor area; by combining several building units, walls can be used jointly; internal partitions can be achieved by room−high wardrobes and curtains, etc.).

• Phasing of building works (Not everything needs to be built at once, a core (nucleus) of 1 to 2 rooms with cooking area and sanitary facilities can be sufficient at the beginning, while plans exist for the extension of the house − horizontally and/or vertically − as the requirement may be).

6.3 Socio−cultural aspects

In order to ensure the success of the project it is important to take the special living conditions of the target group into consideration when planning. That is why it is important to acquire information on the local building methods and involve local professionals in the development of the concept.

The following are some of the aspects to be taken into account during planning:

• Habits, traditions, religious requirements (Are large families with three generations under one roof common? Is the spatial separation of adult men and women strictly practiced? Are bunk beds acceptable? Are toilets acceptable within the living area? Is it necessary to make sure that the toilets are not oriented towards Mecca?).

• Use of the building (Is much space needed for social contacts, e.g. a large living room or roofed outer space, or is the life style more introverted, e.g. with an internal courtyard? Is outdoor sleeping favoured, e.g. on the roof? Is the keeping of livestock or pets important?).

• Security requirements (Do burglaries occur frequently? Do wild animals represent a danger? Is there a danger of social or ethnic conflicts arising in the neighbourhood?).

• Aesthetic values (Are there forms, materials or colours that are preferred or rejected? How important is it for the occupants to be personally involved in the design and decoration? How much can be left to them?).

6.4 Ecological aspects

Ecological building is relatively unknown in many countries, which is why reconstruction projects often provide a good opportunity to incorporate ecological aspects in the design and make the target groups aware of them, provided that the preconditions (funds, products, acceptance) exist. There are numerous ecological design criteria, here are the most important ones:

• Utilisation of local abundantly available materials (which can vary considerably according to the geographical conditions and regional industry. Ecological aspects are the conservation of limited resources, the avoidance of imports and long distance transports, as well as fostering the local industry. Quite often local materials, e.g. clayey soil, exist in unlimited supply, or e.g. bamboo, are quickly regenerated).

• Use of materials which are produced with low energy inputs (meaning less emission of pollutants) (burnt clay bricks require more energy for their production than e.g. concrete hollow blocks; sand lime bricks require even less).

• Avoidance of materials and methods that are dangerous to health (best known example is asbestos cement – to be avoided at all costs – also various wood preservatives, solvents, phosphogypsum, etc. – an environmental expert should always be consulted).

• Utilisation of regenerative resources (e.g. rainwater collection from the roof; composting of kitchen waste; solar energy for water heating and power generation; wind energy for pumping water – however, solar and wind technologies can be expensive to procure).

6.5 The climatic conditions

In order to clarify their climatic differences, the inhabited regions of the earth are roughly divided into the following 5 climatic zones, giving brief information on the corresponding building design requirements:

a. warm humid climate with temperature and humidity levels in the upper limits of the comfort zone (e.g. above 30°C with relative humidity above 50 %), limited cooling at nights and considerable rainfall; building design requirements: **light, non-heat-retaining construction, good cross-ventilation, i.e. large openings.**

b. hot dry climate with extremely high maximum temperatures (often exceeding 35°C) and large drop in night temperatures (to below 15°C), low relative humidity, scarce rainfall, but occasional sand and dust storms; building design requirements: **heavy, heat retaining construction with dissipation of heat during the night, small openings at higher levels.**

c. tropical composite climate with tendencies either to warm humid or hot dry climatic features; building design requirements: **partly heat retaining constructions, in all other points compromises between warm humid and hot dry building design.**

d. tropical highland climate with strong solar radiation, large temperature fluctuations, cold winds and possibility of development of dew; building design requirements: **similar to composite climate, but in addition with heating facilities.**

e. temperate climate with large seasonal temperature fluctuations and extremely cold winters; building design requirements: **heat retaining constructions with moisture barriers and heat insulation, as well as additional heating facilities.**

6.6 Protective measures against natural hazards

6.6.1 Earthquakes

• Provided there is an option, avoidance of sites on or near slopes (danger of landslides, avalanches) and coastal sites (danger of tidal waves), sufficient distance from neighbouring buildings (danger of collapse), especially in the main wind direction (danger of flashing over of fire), and downstream from dams (danger of dam burst), no constructions within the area of collapse of bridges.

• As far as possible, rigid ground conditions (preferably rock), because earthquakes can lead to the liquidation of the soil and thus deprive the foundations of its support; filled up ditches and river beds are especially to be avoided.

• Symmetrical shapes of buildings (no L−, T− or U−shapes), also, as far as possible, symmetrical arrangement of rooms.

• Design of foundations such that they offer no impact surfaces for seismic forces, i.e. avoidance of different heights of strip foundations, no stepping of foundations on slopes. In smaller buildings: reinforced, sufficiently dimensioned slab foundation, preferably with a vertical strip along the edge, provides highest earthquake resistance. Reinforcement, slab thickness and concrete quality have to be based on structural calculations. For larger buildings it is essential to involve an experienced structural engineer.

• In the case of small buildings, light construction, in order to avoid major damage by falling debris, as well as strong connections between building components. At corners (and also around larger openings) installation of sufficiently dimensioned reinforced concrete or timber elements. A continuous ring beam above the doors and windows, and firmly fixed to the walls and corner posts is absolutely essential.

• It is also essential to involve an experienced structural engineer in the case of larger buildings (two−storeyed and higher). Projections (both horizontal and vertical) should be avoided, unavoidable projections have to be especially well fixed to the main structure.

• Windows and doors should not be placed at corners of buildings (as they reduce the building's stability and thus represent an earthquake hazard). In the case of glass breakage, it is easier and cheaper to replace smaller panes.

• Water tanks on the roof have to be especially well constructed, in order to avoid collapse during an earthquake. Better: free−standing water tanks with especially strong supporting structure.

• Regular control of the strength of structurally important building components and connections (because of the danger of weakening of material due to corrosion, termite attack, decay, etc.).

6.6.2 Hurricanes

• Avoidance of constructions on exposed sites without protective vegetation or dense building clusters, avoidance of flood prone locations (lowlands, vicinity of rivers).

• Roof slopes at least 30°, to reduce suction forces (suction is highest at 10°). Strong connections of all roof components to the roof structure, but danger of rusting of all iron parts must be taken into consideration.

• Avoidance of large roof overhangs and projections, because of danger of lift−off. On the other hand, heavy rains may make large overhangs necessary. Therefore, predetermined breaking points along the line between roof and wall can be a solution.

• Strong wind bracing in roof and walls, otherwise principally the same structural precautionary measures as for earthquakes.

• Wind protection through vegetation, but also precautions to be taken, so that trees cannot fall on the house.

6.6.3 Fire

• The use of fire resisting materials should be first priority.

• Chemical treatment of building parts, but only as emergency solution, because regular renewal is necessary and washed out impregnating chemicals can be toxic.

• Provision of fire fighting equipment and reservoirs for adequate water supplies.

6.6.4 Solar radiation, intense heat

• Shading by means of roof overhangs or individual elements above or in front of windows.

• Ideally, complete shading of facade, to avoid overheating. Alternatively the outer walls can be double−layered with a naturally ventilated air cavity (i.e. with openings above and below) − thereby enabling the heat that penetrates the outer skin to be dissipated by the natural ventilation in the cavity, thus preventing the inner layer from heating up. A reflective treatment of the façade can keep out most of the heat, while an aluminium foil covering the outer surface of the inner layer provides an additional barrier against heat penetration into the building.

• In hot dry areas, thick, heat retaining outer walls prevent the quick penetration of solar heat. They should be dimensioned such that the heat reaches the interior in the evening, when the air temperature falls below the comfort level − in this way, comfortable room temperatures are achieved day and night without technical means (air−conditioners, heaters). A suitable wall thickness cannot be recommended as it depends on the heat retaining features of the wall construction material, the construction system, the surface texture and colour, as well as on the prevailing day and night temperatures. With the corresponding information, a building physicist can calculate the required wall thickness.

• Vegetation can provide shade and minimise glare. Especially in hot dry areas, avoidance of light coloured, smooth ground cover (glare and heat reflection).

6.6.5 Extreme cold and snow

• Foundations must be below frost level, otherwise there is a danger of building components being lifted up when ice develops.

• The complete outer skin (wall and roof) must be clad by a thick heat insulating layer, in order to prevent the loss of heat from inside the building. As far as possible, the heat retaining wall should be on the inner side, so that the heat stored in it can be returned to the interior. The heat insulation must be protected externally against moisture and mechanical damage (e.g. by a layer of plaster, wooden cladding, etc.).

• The roof construction must take the expected snow loads into consideration, good drainage must ensure the quick removal of melting snow and ice.

• The windows should be double glazed, doors and windows must close tightly in order to prevent heat loss. They must, however, able to be opened so that the humidity that develops inside is allowed to escape (important to prevent the development of fungus and rot). Wind traps should be designed at entrances.

• Sufficient heating facilities (depending on availability, using oil, gas, coal, electricity) have to be incorporated in the design, corresponding spaces for reserve supplies (oil, coal, firewood), chimneys/exhaust pipes (oil, gas coal), or sufficient electricity must be provided.

6.6.6 Rain

• Avoidance of flood prone locations (lowlands, vicinity of rivers).

• Sloping roofs, roof overhangs sufficient to protect windows and outer doors.

• Since tropical rains are particularly heavy, sound proofing of the roof is important, e.g. by fixing insulating panels directly below the roof elements, by an air space between the ceiling and roof, by fixing felt or rubber washers at connection points, and so on.

• Avoidance of internal drainage and roof valleys, as gutters can get blocked by leaves and dirt and prevent drainage of water. Site drainage must function particularly well.

• Floors must be higher than the outdoor area in order to prevent water from entering the building.

• Recommendation: dark paint at plinth level, at least 30 cm high (above outdoor ground surface), in order to avoid ugly stains of splashing water.

6.6.7 Sand

• Smooth outer surfaces of buildings, no horizontal projections or recesses, in order to avoid sand deposits.

• Protective walls up to or window openings above 1.60 m, since wind carried sand rarely reaches higher levels. Dust, on the other hand, cannot be excluded.

• Soft ground surfaces close to the house, as well as bushes and trees, in order to check wind carried sand.

6.6.8 Termites

• Use of termite resistant building materials (only resistant timber or no timber at all).

• Impregnation of wooden parts, but beware of exposed surfaces (danger of poisoning through direct contact). Preferably only structurally important parts should be impregnated, which are subsequently concealed by other materials or by a non−toxic paint.

• Metal termite shields fixed at all places accessible from the ground − e.g. along the top edge of the plinth − actually mainly for inspections, so that the development of termite tunnels is quickly identified and protective measures can be implemented. Impregnation of the ground around the house is practiced occasionally, but is not advisable, because of the health hazards to humans and domestic animals.

6.6.9 Fungus

• Maintenance of dry conditions by means of ventilation and keeping a good distance from ground moisture.

• Use of dry, fungus−proof timber or building materials that do not absorb moisture.

• Protective paints, e.g. milk of cement or lime, non−oil−based glue paint, using a fungicide as primer.

7. Bibliography

7.1 General Literature

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4. Kreimer, Alcira, et. al.: **The World Bank's Experience with Post−Conflict Reconstruction,** World Bank Group, Washington D.C., 1998

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7.2 GTZ Publications

9. GTZ: **Development−oriented Emergency Aid (DEA) − GTZ's working principles,**

Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Eschborn, 1998

10. GTZ (Abteilung 4300): **Entwicklungsorientierte Nothilfe (EON) − Flüchtlings− programme,** Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Eschborn, 2001

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12. GTZ (Division 4300): **Disaster Risk Management − Working Concept,** Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Eschborn, 2002

8. GTZ building projects within the framework of DEA

Year	Project	Client	Contract sum in million euros
1992−1993		AA	25.565

	Refugee settlements, building rehabilitation and extension as humanitarian aid in Croatia		
1993–1996	Construction of refugee settlements in Azerbaijan	ECHO	16.600
1996–2003	Rehabilitation of schools and housing for returning refugees in Jaffna, Sri Lanka	BMZ	3.684
1995–1997	Rehabilitation of housing and schools in Tuzla Canton, Bosnia & Herzegovina	AA	6.698
1997–1998	Restoration and reconstruction of war damaged buildings in the Fizuli Region in Azerbaijan	ECHO	2.090
1998	Construction of new housing for refugees returning to Gradacac/Modrica, Bosnia & Herzegovina	Düren City, EU, BMZ	1.253
1998	Reconstruction after earthquake in Southern Turkey	BMZ	1.030
1998–1999	Provision of accommodations for refugees from Kosovo in Albania	BMZ	2.556
1999	Wiederaufbaumaßnahmen in Freetown/Sierra Leone	BMZ	0.691
1999–2000	Emergency aid and reconstruction measures after earthquake in Colombia	BMZ	1.074
1999–2000	Housing and social facilities for earthquake victims in Western Turkey	BMZ	12.017
2000–2001	Rehabilitation of schools after floods in Cambodia	BMZ	0.375
2000–2001	Provision of housing for Afghan refugees in Pakistan	BMZ	0.740
2000	Reconstruction measures after floods in Venezuela	BMZ	1.020
2001	Reconstruction of housing after earthquake in Peru	BMZ	1.020
2001 –2002	Reconstruction of housing after earthquake in El Salvador	BMZ	1.834
2001 –2003	Reconstruction of a school after earthquake n Gujarat/India	Bild–Hilft e.V.	0.880
2002–2003	Emergency aid and reconstruction measures in Afghanistan	BMZ	7.050
2002	Support of the Emergency Loya Jirga in Kabul, Afghanistan	UNDP	8.100

9. Annexes

IMPORTANT NOTE

This section contains a series of documents concerning building measures and contracts, which the GTZ has developed according to its own very specific requirements over many years, and which it applies in its projects. They make no claims to being universally applicable. They have been included in these Guidelines to provide information and examples for third parties involved in the implementation of building measures within the framework of development cooperation, emergency aid and especially in the planning and execution of building projects. All documents have to be analysed very carefully in each individual case and have to be adapted to the specific conditions and requirements of the respective countries and business partners. The contract partners are solely responsible for the use of the documents.

The GTZ accepts no responsibilty for any problems or inconsistencies that may arise by the use of the documents presented here, either unchanged or in modified form.

Most of the documents were prepared in English. French and Spanish versions also exist at GTZ. The authors

9.1 Questionnaire for Architects/Engineers and Contractors (QUARCENG)

1.	name of firm, full address, international telephone and telefax numbers:

2.	structure of firm:	
	legal form:	year of formation:
	proprietor:	original capital:

3.	bank references:	

4.	technical equipment:

5.	annual turnover:		in: *currency*		
	1999	2000	2001	2002	2003

6.	permanent personnel:		
	number	field of activity:	qualification:

7.	reference projects **completed** during the last five years:				
	name of project:	type of project:	remuneration/fee	period of construction	client

	reference projects commenced and still under construction:				
	name of project:	type of project:	remuneration /fee	period of construction	client

8.	membership of association(s)

9.	the undersigned declare(s) that the statements made in this questionnaire are both correct and complete.	
	....	....
	place and date	legal seal and signature(s)

10.	enclosures and/or remarks:

9.2 Bidding Conditions for Consultants/Architects (BIARCENG)

1. THE BID

For the purpose of a comprehensive evaluation the bid should contain the following information:

1.1 Details of the design concept and/or working concept including information about the construction method envisaged as well as

(1) Estimated time schedules for preparation of the planning, compiling specifications and Bill of Quantities, tendering period, and the execution of the construction phase.

(2) Details of the resident engineer(s) proposed for this/these position(s) including his/their curriculum vitae.

(3) Brief listing of reference projects completed.

1.2 Statement about the earliest possible date for commencing the works.

1.3 The completed questionnaire (QUARCENG).

2. COST OF PREPARING THE BID

The bid with all enclosures shall become the property of the General Contractor upon delivery.

No remuneration shall be granted for the preparation of the bid and all the documents attached thereto.

3. ADDRESS OF BID

Bids must be delivered in a separate, closed envelope, lettered

Project No.............................	**"BID FOR** ...."
to (Address of General Contractor)	**c/o** ....

4. Any modification to or withdrawal of the bid must be notified in writing to the above mentioned address prior to the closing date for submission of bids.

5. Agreements with third parties in restraint of competition to the disadvantage of the General Contractor are not admissible and shall result to exclusion of such bids.

9.3 Contract for Architectural Consult Consulting Services (CONTRARC)

The	Date ....
Address of the General Contractor	reference to in all correspondence:
....	Contract No.:
....	....
....	
	Project No.:
– hereinafter referred to as the **"Employer"** –	....

and

....

....

....

– hereinafter referred to as the **"Consultant"** –

herewith enter into the following Contract for the Project

....

Country:

....

1. Purpose of Contract

(e.g. contribution of the construction works towards the goal of the project)
....
....
....

2. Scope of Services

In order to achieve this purpose, the Consultant shall perform services according to the stipulations in the subsequent clauses for the construction of:

(number and type of building(s), listing of the space requirements, type of construction, etc; if applicable, reference shall be made to the project information in the Annex)

3. Three Phases of Contract

3.1 By signing this contract, the Employer commissions the Consultant with the services pursuant to Section 4 (Phase 1), only.

3.2 If the planning work shall be continued, the Employer has an option to commission the Consultant with the services specified in Section 5 (Phase 2).

3.3 In case of execution of the construction work, the Employer has a further option to commission the Consultant with the task of site supervision described under Section 6 (Phase 3).

3.4 The Employer reserves the right to limit the assignment to individual services of Phase 2 or 3.

3.5 The assignments pursuant to Sub−Sections 3.2. and 3.3 shall be made in writing.

3.6 The Consultant shall be bound to provide the relevant services if the Employer exercises an option within 12 months after acceptance of the results of the previous phase. On the other hand, the Consultant shall not have a legal claim to the assignment of services of Phase 2 or 3. The Consultant cannot derive any increase in remuneration from the limitation of assignment to individual services of Phase 2 or 3. Nor shall the Consultant have the right for a claim for remuneration of any phase or individual service with which he has not been commissioned.

4. Phase 1 (Preparation of the Documents for Building Permission)

Within this phase the Consultant shall execute the following services:

4.1 Establishing whether cadastral maps, surveyors' plans, soil investigations or other documents of the building site exist. If not, or if the existing documents do not suffice, procurement of appropriate tenders and assignment after prior written approval by the Employer. Costs arising from this procurement shall be paid as reimbursable expenditures in addition to the remuneration as laid out in Section 9.

4.2 Sketching of a preliminary design and presenting the same to the Employer, which must be approved by the Employer prior to proceeding.

4.3 Preparation of a site layout plan on a scale of 1:500 or 1:200, including outdoor facilities.

4.4 Preparation of preliminary design plans for the buildings and outdoor facilities on a scale to be agreed with the Employer of 1:200 or 1:100.

4.5 Preparation of the explanatory report for the buildings and outdoor facilities in accordance with
EXPLARER

4.6 Preparation of a cost estimate for the buildings and outdoor facilities (using blank specimen of COSTESTM) and calculation of areas (gross floorplan area according to customary local standard).

4.7 Drawing up of a preliminary structural analysis.

4.8 Drawing up of preliminary plans of the technical installations, such as for sanitary, electrical, and possibly telecommunicative and/or mechanical purposes, including:

(1) Rough estimate of technical requirements and output values.
(2) Contribution to the explanatory report pursuant to EXPLARER
(3) Cost estimate according to empirical values pursuant to COSTESTM.

4.9 Obtaining of building permission and other permits required for the execution of the works in the recipient country.

5. Phase 2 (Preparation of the Construction Documents)

Within this phase the Consultant shall execute the following services:

5.1 Architectural design planning:

5.1.1 Preparation of the final design plans for construction:

(1) layout plan on a scale of 1:500 or 1:200,

(2) floor−plans, sections and elevations for all buildings/structures on a scale of 1:100,

(3) plans for the outdoor facilities on a suitable scale.

5.1.2 Preparation of the working drawings on a scale of 1:50, important details on a scale of 1:10, 1:5 or 1:1 and all outdoor facilities on a suitable scale.

5.2 Structural planning:

(1) elaboration of the structural analysis suitable for review and approval,

(2) preparation of positional drawings for the structure,

(3) preparation of formwork drawings as supplement to the working drawings pursuant to Section 5.1.2,

(4) drawings of construction elements with instructions for installing the same (e.g. reinforcement plans, plans for structural steelworks and woodwork),

(5) compilation of detailed steel and/or other lists of structural materials.

5.3 Planning of mechanical, electrical and sanitary and/or other installations:

(1) Determination of technical requirements and output values.
(2) Dimensioning of all equipment and parts of installations.
(3) Pertaining drawings on a scale of 1:100.
(4) Determination of pipe channels and openings in walls, ceilings and floors.
(5) Working and detail drawings on a scale to be agreed with the Employer.

5.4 Services for the award of construction contract according to the Employer’s instructions:

(1) Compilation of the specifications with technical preface.

(2) Calculation of quantities and preparation of the Bill of Quantities.

(3) Calculation of costs of the buildings and outdoor facilities based on the Bill of Quantities.

(4) Adaptation of the form and content of the Tender Documents for Contractors, specified by the Employer, to the special conditions of the building site and building(s) to be built.

(5) Conducting of pre–qualification procedures for contractors, including their evaluation.

(6) Proposal of contractors to be invited to tender (preparation of short list).

(7) Submission of complete tender documents for review and approval to the Employer.

(8) Conducting of the tendering action according to Tender Conditions, if instructed to do so by the Employer.

(9) Evaluation of the Tenders received, including elaboration of proposal for the award of contract.

(10) Conducting of or participating in contract negotiations, if requested by the Employer.

6. Phase 3 (Site Supervision)

6.1 The Consultant shall assume all engineering functions and duties in accordance with the contractual provisions made between the Employer and the building contractor *which are based on the FIDIC Terms of Contract*[1]*.*

[1] delete if not applicable

Without claiming to be complete, the functions and duties are as follows:

6.1.1 Technical Services:

(1) Due and proper supervision of the execution of the construction work and mechanical, electrical and all other installation works to ensure that they conform with the specifications and drawings, the recognized engineering principles and all applicable regulations.

(2) Provide technical advice and necessary support to all personnel assigned to the project.

(3) Examination and approval or rejection of materials for construction work supplied by the contractor(s).

(4) Amending of the working drawings in accordance with the actual execution of the works (see paragraph 7.2.3 (1)).

(5) Technical inspection of the execution of the structure to ensure that it conforms with the approved structural documents.

(6) Technical inspection of auxiliary construction requirements; e.g. scaffolding, craneways, excavation supports, etc.

(7) Inspection of concrete production and processing at the building site and evaluation of quality controls.

(8) Follow–up of the working progress schedule provided by the building contractor or, if not available, own compilation of a suitable programme (e.g. bar chart) which has to be agreed to and signed by the contractor.

(9) Keeping of a construction diary.

(10) Joint measurements of the work in place with the building contractor. This includes the preparation of special measurement records for work that cannot be measured after the construction work has been completed. They shall be confirmed in writing by the building contractor and the Resident Engineer (Not applicable for lump sum contracts).

(11) Upon special request of the Employer, intermediate acceptance of construction work (e.g. acceptance of the rough structure).

(12) Preparation of and participation in taking−over procedures by the Employer; independent taking−over, if instructed to do so by the Employer (TAKGOVER).

(13) Participation in the handing−over of the completed project, compilation and handing over of the necessary documents; independent handing over and drawing up of the handing−over certificate to the project executing agency/beneficiary, if instructed to do so by the Employer (HNDGOVER).

(14) Inspections during the Contractor's defects liability period and supervision of rectification of any faults and defects that may occur.

6.1.2 Commercial Services connected with the construction

(1) Checking and, if necessary, correction of invoices, reports, lists, etc. of the building contractor(s) within the periods stipulated in the contract between the Employer and the contractor(s). Calculations of quantities, accounting files and cost calculations shall be checked for technical and arithmetical accuracy and certified by date and signature. In order to show that this has been done, the Consultant shall tick all correct values and amounts reported.

(2) Examination of new prices for additional or amended services to ensure that they are in line with the cost estimate of the original tender on which the Contract is based as well as the current local situation.

6.2 Assignment of Personnel for Site Supervision

6.2.1 In order to supervise the construction work, the Consultant shall assign during the period from approx....................to..................the following personnel:

1) Resident Engineer: ....

2) ....

3) ....

Any change of assigned personnel require(s) prior written approval of the Employer.

6.2.2 The beginning and the end of the period of assignment shall be stipulated in writing when the Consultant is commissioned with Phase 3 according to Sub−Section 3.3.

6.3 Reports

6.3.1 The Consultant shall submit

• monthly reports on the progress of construction in accordance with PROGREP, including a progress diagram, photographs and other relevant data as well as details on completed work, percentage of completion, basic climatic conditions and average number of workers on site, special incidents, work forecast, etc.,

• a final report two months after completion and taking−over of the construction works, comprising:

(1) a description of the progress of the entire project from planning to taking−over or handing−over, comments about the construction period, listing major problems encountered during construction and how these were solved; and

(2) an overview and tabulation of the total costs compared with the calculation according to COSTESTM.

6.3.2 Special reports shall be forwarded to the Employer without delay in case of important incidents or circumstances that may occur. Each such report shall include in particular events and circumstances that give rise or may give cause to claims against the Building Contractor(s) commissioned with the execution of the construction work.

6.3.3 All reports shall be submitted two the Employer in duplicate in English language.

7. Documentation

7.1 All documents shall clearly indicate that they were produced on behalf of the Employer. The title block of the drawings shall be approved by the Employer. All documents shall be drawn up in English language.

7.2 The Consultant shall provide the following number of copies:

7.2.1 Phase 1:

Documents for Building Permission pursuant to Section 4	3 copies

7.2.2 Phase 2:

(1) Final design plans pursuant to Section 5.1.1	8 copies
(2) Working drawings, structural analysis, positional drawings, formwork and reinforcement plans, lists and installation drawings pursuant to Sections 5.1.2, 5.2 and 5.3	4 copies
(3) Specifications and Bill of Quantities pursuant to Sections 5.4 (1) and (2)	12 copies
(4) Reproducibles of final design and working drawings	.....sets

7.2.3 Phase 3:

(1) As−built drawings (copies folded to DIN A 4 size) for all buildings and outdoor facilities, including structures and installations.	3 copies
(2) Photographs of all buildings/installations after completion.	3 copies
(3) Updating of the calculations of areas in accordance with the actual execution of construction work.	3 copies

8. Deadlines

The following deadlines shall apply for the services performed by the Consultant:

(1) First submission of the preliminary design pursuant to Sub−Section 4.2:
..... weeks after signing the contract

(2) Preparation of all Documents for Building Permission pursuant to Section 4:
..... weeks after approval of the first preliminary design

(3) Preparation of the Construction Documents pursuant to Section 5:
..... weeks after being commissioned pursuant to Section 3.2.

(4) Completion and submission of the final report pursuant to Sub−Section 6.3.1:
..... weeks after acceptance and taking over of the works

9. Remuneration

9.1 The Consultant shall be entitled to the following remuneration:

9.1.1 Phase 1 the lump sum of ....

9.1.2 Phase 2 the lump sum of ....

9.1.3 Phase 3

(1) For a full time Resident Engineer for overall site supervision during the construction period of approximately.......months the lump sum of ....

(ALTERNATIVE)

(1) For a part time Resident Engineer (.....%) for overall site supervision during the construction period of approximately months the lump sum of ....

(2) For part time special supervision (e.g. structural, sanitary, electr., mechanic, etc.), as required during the contract period the lump sum of ....

(3) For the Documentation of Phase 3 (Section 7.2.3) and the Final Report pursuant to Section 6.3.1 the lump sum of ....

Sub Total for Phase 3 ....

9.1.4 Total Remuneration ....

(in words: ....)

9.2 All lump sums and expert/month−rates as stated above are fixed prices and shall include all costs incurring in connection with the performance of these services.

9.3 The Consultant shall invoice turnover tax if and as prescribed by law; the Employer will refund the amount in addition to the remuneration.

Amount of turnover tax *(if applicable):* ....

10. Terms of Payment

Payment of the remuneration shall be made in .... *(currency)* upon receipt of the Consultant's invoice in duplicate as follows:

10.1 Phase 1: 95% after acceptance of the respective services by the Employer.

10.2 Phase 2: 95% after acceptance of the respective services by the Employer.

10.3 Phase 3:

10.3.1 80 % of the remuneration stipulated in Sub−Sections 9.1.3 (1) and (2) in monthly payments of................*(currency/amount)* upon presentation of an invoice in duplicate, starting one month after the commencement of the construction works.

10.3.2 15 % of the remuneration stipulated in Sub−Section 9.1.3 (1) and (2) after acceptance of the construction work and presentation of the Taking−Over Certificate (TAKGOVER).

10.3.3 100% of the remuneration stipulated in Sub−Section 9.1.3 (3) after acceptance of the services by the Employer.

10.4 The 5 % remaining under Sub−Sections 10.1 to 10.3.2 above shall be remitted upon expiry of the warranty period. The amount retained for this period shall be disbursed following taking−over without defects upon provision of a guarantee by a bank accepted by the Employer in accordance with the specimen enclosed (GARANTDL).

11. Statute of Limitation of Claims of the Consultant

The claims of the Consultant arising from the Contract shall become statute−barred unless they are asserted vis−a−vis the Employer in writing within 6 months following the end of the contractually agreed period of assignment or after acceptance of the work.

12. Duty of Care and Exercise of Authority

12.1 The Consultant shall exercise reasonable skill, care and diligence in the performance of his obligations under the Contract and shall observe all local regulations in force.

12.2 Regarding any claims of the Employer against the Building Contractor or any third party, the Consultant shall take the necessary measures to protect rights provisionally if and to the extent that the Employer cannot be informed in good time.

12.3 Where the Services include the exercise of powers or performance of duties authorised or required by the terms of the contract between the Employer and the Building Contractor, the Consultant shall

- act in accordance with this contract and the contract between the Employer and the Building Contractor,

- if authorized to certify, decide or exercise discretion, do so fairly between the Employer and the Building Contractor not as an arbitrator but as an independent professional acts by his skill and judgement.

13. Warranty Period

The warranty period of the services of the Consultant shall be two years, beginning with the taking−over of the construction works, but not later than six years after acceptance of the services in question.

14. Insurance for Liability

14.1 The Consultant undertakes to take out an insurance for liability for damage caused negligently by the Consultant, his staff and other persons he engages for or in connection with the implementation of the Contract to the Employer, the recipient of the works in the country of assignment or to third parties.

14.2 The insurance sum shall be as customary in the country where the works are to be executed.

14.3 Upon request, the Consultant shall prove to the Employer his insurance coverage.

15. Copyright

The Consultant retains copyright of all documents prepared by him. The Employer shall be entitled to use them or copy them only for the Works and the purpose for which they are intended, and need not obtain the

Consultant’s permission to copy for such use.

16. Conflict of Interest

Unless otherwise agreed in writing by the Employer, the Consultant and his personnel shall have no interest in nor receive remuneration in connection with the Project except as provided for in this Contract. The Consultant shall not engage in any activity which might conflict with the interest of the Employer under this Contract.

17. Applicable Law

German Law shall apply to this contract.

18. Arbitration

All disputes arising in connection with the present Contract shall be finally settled under the Rules of Conciliation and Arbitration of the International Chamber of Commerce by one or more arbitrators appointed in accordance with the said rules.

19. Modifications and Alterations

Any modifications, additions and/or deletions to this contract as well as all fundamental communication must be made in writing only.

20. Termination of the Contract

20.1 The Employer may terminate the Contract at any time either wholly or in respect of individual parts of the work or the services.

20.2 Should the Employer terminate the Contract for a reason for which the Consultant is not answerable, the Consultant shall be entitled to demand the agreed sum in remuneration. However, he shall agree to non–incurred expenses or avoidable expenditure being deducted from the sum otherwise due. Salaries and ancillary costs in respect of salaries for the experts of the Consultant assigned to the project shall as a rule be deemed not incurred if they would have become due more than 3 months after the date on which termination of the Contract took effect. The Consultant shall bear the burden of proof for exceptions to this rule.

20.3 If the Employer terminates the Contract for a reason for which the Consultant or its experts are answerable, remuneration shall be paid only for the works already executed, provided that the Employer can utilize them, in accordance with the Contract prices, or, that part actually executed shall be remunerated as a proportion of the total contractual works on the basis of the Contract prices. Those works executed which the Employer cannot utilize shall be returned to the Consultant at the latter’s expense. Insofar as the contractual work comprises the rendering of services, the services rendered up to the date of termination shall be deemed utilizable works. In no case shall there be a claim to more than the contractual amount.

20.4 The Consultant shall be deemed answerable for the reason for termination if the Employer terminates because bankruptcy proceedings have been initiated against the assets of the Consultant, or because judicial composition proceedings have been initiated against the Consultant, or it has discontinued its payments not only on a temporary basis, thus jeopardizing the proper execution of the Contract.

20.5 Other legal rights and claims of the Employer and Consultant shall remain unaffected.

21. Partial Invalidity

The invalidity of one or several provisions of this Contract shall not affect the validity of the remaining provisions. Invalid provisions shall be substituted by such provisions as are closest to the economic purpose aimed at by both contracting parties.

22. Copies

This Contract shall be drawn up in duplicate and each party shall receive one copy thereof.

.... (place) .... (date)

....

THE EMPLOYER THE CONSULTANT

List of Annexes:

BIARCENG	Bidding Conditions for Consultants/Architects
__________	Project Information (if applicable):
	(Information about location and condition of site, type and number of buildings/installations planned, space requirements, exterior facilities, landscaping)
EXPLAREP	Guide for the Preparation of the Explanatory Report
COSTESTM	Form of Cost Estimate
GARANTAP	Specimen of Advance Payment Guarantee (if applicable)
GARANTDL	Specimen of Bank Guarantee for the Defects Liability Period
PROGREP	Specimen of Construction Progress Report
TAKGOVER	Form of Certificate of Taking–Over
HNDGOVER	Form of Handing–Over Certificate
QUARCENG	Questionnaire for Architects/Engineers

the following Annexes will be handed over with the award of the Contract:

__________	Copy of Project Agreement (if applicable)
INVTDFID	Form of Invitation to Tender (FIDIC Contracts)
TENDRFID	Form of Tender (with Appendix) for Contractors (FIDIC Contracts)
TENDRCON	Tender Conditions for Contractors (FIDIC Contracts)
FIDIC–P2	Conditions of Particular Application (FIDIC II)
GARANTPF	Specimen of Performance Guarantee (if applicable)

ALTERNATIVE to FIDIC–Contracts (instead of the above 6 annexes):

INVTDLMB	Form of Invitation to Tender for Contractors (for Contracts of Construction Works on Lump sum or Measurement Basis)
CONCTRMB	Contract for Construction Works on Measurement Basis,
CONCTRLB	Contract for Construction Works on Lump sum Basis *(Alternative to CONCTRMB)*

9.4a Form of Cost Estimate (COSTESTM)

COST ESTIMATE
for

Budgeting Purposes **– Construction –**

Supplement No.: .... dated: ....

Project No.: ....
Project Name: ....

Prepared by:	
....	....
(Architect/Consultant)	(place, date, signature)
Reviewed and approved:	
....	....
(General Contractor)	(place, date, signature)

Numbers of the subtotals correspond to items of the Explanatory Report (EXPLAREP)

Estimated Cost Summary	**Euro**
Subtotal 1: Construction site	....
Subtotal 2: Site Development	....
Description of buildings/parts of buildings	Euro
	....
	....
	....
	....
	....
______________________________	____________
Subtotal 3: Buildings	....
Subtotal 4: Technical Installations/Equipment	....
Subtotal 5: Exterior Facilities	....
Subtotal 6: Additional Measures	....
Subtotal 7: Architect's/Consultant's Fee	....
Contingencies	....
Total of Cost Summary*/of Supplement N°...: *	....

* Total costs as per original cost estimate	....

Total costs as per	Supplement N° 1	....
	Supplement N° 2	....
	Supplement N° 3	....
Grand Total		**.........................**

* *Delete which is not applicable*

NOTE: The calculations of the cost estimates listed above with the calculations of the gross floor areas are to be attached for review and approval as enclosure to this COST ESTIMATE

9.4b Explanatory Report (EXPLAREP)

Guide for the Preparation of the
EXPLANATORY REPORT

For the *(insert name of construction project)* PN:......................................

....

....

0. Planning

(1) General information (e.g. design layout, compliance with functional design)
(2) Compliance with space requirements
(3) Requirements under public law (compliance with local rules and regulations)
(4) Possibilities for future extension

1. Construction Site

(1) Number of parking spaces for vehicles

(2) Evaluation of the location in or with respect to the next town/village

(3) Information regarding the development of the construction site, possible need for major earth movements

(4) Evaluation of the lots/buildings adjacent to the construction site *)

(5) Bearing capacity of the soil, results of soil investigations

2. Site Development, Technical Infrastructure

(1) Access roads; transportation facilities

(2) Water supply

(3) Sewage and waste water disposal

(4) Supply of electricity

*) Photographs shall be enclosed, if considered relevant

3. Buildings/Parts of Buildings

(1) Foundations
(2) Walls, exterior and interior
(3) Ceilings
(4) Stairs and landings
(5) Roof, gutters, downpipes
(6) Chimneys, air supply/smoke exit ducts
(7) Sun protection (louvres, screens, Venetian blinds)
(8) Ceiling and wall finish
(9) Floor finish
(10) Facade finish
(11) Exterior and interior doors
(12) Windows, dome lights, window grills
(13) Energy conservation measures
(14) Fire prevention measures

4.1 Technical Installations and Equipment

(1) Water and waste water, supply, treatment, and disposal
(2) Air conditioning, mechanical ventilation, air ducts
(3) Gas and liquids
(4) Electricity, distribution within the building(s)
(5) Means of telecommunications
(6) Heating system
(7) Lightning protection

4.2 Special Features/Elements

(1) Special structures
(2) Special installations
(3) Special technical equipment
(4) Special fixed features
(5) Elements of art involving artistic design

5. Exterior Facilities

(1) Fences, walls
(2) Drainage and sewage disposal
(3) Electricity supply system
(4) Special–purpose installations (transformer station)
(5) Roads, parking areas, walkways
(6) Green areas
(7) Other outdoor features (playgrounds)

6. Additional Measures

State if provisions are foreseen for construction work during rainy seasons or snow and frost periods respectively

9.5 Form of Invitation to Tender for Construction works (recommended for contracts value up to 150,000 Euro) (INVTD150)

> Employer's I Consultant's letterhead <

Date:.....................
Negotiated Procedure for

Project No.:.....................

Submission/Opening Date:
in ....
on .... (day)
the .... (date)
at .... (time)

....
....
(Contractors address)

INVITATION TO TENDER
(Building Construction Works)

1. Subject :...

(insert name of project)

Dear Sir or Madam,

The...........................***(Name I Address of Employer)***..
....
hereinafter referred to as "The Employer",
intends to...
....
....

(insert brief description of building(s)/installation(s))

The execution of the Works will be performed within the frame of the Technical Cooperation between........*(Donor Country)*.....................and the ....
(recipient country).

It is intended to award the contract for the Works as detailed in the attached Drawings, Specifications and Bill of Quantities.

2. The Tender Documents consist of

2.1 Specimen of Contract for Construction Works on Measurement/Lump sum* Basis (in duplicate)

2.2 Specifications with Bill of Quantities – in duplicate

2.3 .... Drawings No............., dated...............
.... Drawings No..............dated...............
.... Drawings No..............dated...............

2.4* * Specimen of Advance Payment Bank Guarantee

2.5** Specimen of Defects Liability Guarantee

3. Further information, regarding the intended project, may be obtained.at

....
(insert detailed address)

during normal office hours.

4. In the event that the Bill of Quantities provides for a division of the Works into separate lots, the Employer reserves the right to award separate contracts for those lots.

5. If you are willing to execute the Works you are requested to send or hand in the enclosed Contract for Construction Works on Measurement/Lump sum* Basis together with all annexes, exclusively prepared in the English language, completed and signed by a duly authorized person, in a sealed envelope, not later than stated as submission date on the front page to/at

....

* Delete inapplicable alternative
** Delete inapplicable item

The Contract for Construction Works on Measurement/Lump sum* Basis together with all annexes shall be submitted in double packing. The inner packing shall be sealed and labelled as follows:

TENDER FOR PN: ....
PROJECT NAME: ....

The period for submission of Tender shall expire with the date and time mentioned in the letter head. Tenders may be withdrawn by letter, telex, telegraph, or fax, prior to the submission time and date.

6. The period of adjudication begins with the submission/opening date and expires on the ....(date).......... The Tenderer is bound to his Tender until this date.

7. Your confirmation of the receipt of the tender documents would be appreciated. If you are not interested in submitting a Tender, please return the enclosures blank as soon as possible.

Employer or The Authorized Representative

9.6 Form of Invitation to Tender for contracts value above 150,000 Euro (INVTDFID)

> *Employer's I Consultant's letterhead* <

Date:.....................
Negotiated Procedure for
Project No.:.....................

Submission/Opening Date:
in ....
on .... (day)
the .... (date)
at .... (time)

....
....
(Contractors address)

INVITATION TO TENDER

1. Subject :..

(insert name of project)

Dear Sir or Madam,

The..........................***(Name I Address of Employer)***..
....
hereinafter referred to as "The Employer",
intends to...
....
....

(insert brief description of building(s)/installation(s))

The execution of the Works will be performed within the frame of the Technical Cooperation between........*(Donor Country)*....................and the
....
(recipient country).

It is intended to award the contract for the Works as detailed in the attached Drawings, Specifications and Bill of Quantities.

2. The Tender Documents consist of

2.1 Tender Conditions for Contractors

2.2 Tender with Appendix – in duplicate

2.3 Specifications with Bill of Quantities – in duplicate

2.4 .... Drawings No.............dated..............

.... Drawings No............, dated..............

.... Drawings No............, dated..............

2.5 Part II – Conditions of Particular Application (Supplement to Part I of the International Conditions of Contract for Works of Civil Engineering Construction – FIDIC, fourth edition 1987, reprinted 1992 with amendments)

2.6 Specimen of Advance Payment Bank Guarantee

2.7 Specimen of Performance Guarantee

2.8 Specimen of Defects Liability Guarantee

3. The Contract for the Works is based on the "Conditions of Contract for Works of Civil Engineering Construction" FIDIC – Part I, General Conditions, prepared by the Fédération Internationale des

Ingénieurs–Conseils, fourth edition 1987, reprinted 1992 with amendments, which are not enclosed but may be examined at

....
(insert detailed address)

during normal office hours. Further information may also be obtained.

4. In the event that the Bill of Quantities provides for a division of the Works into separate lots, the Employer reserves the right to award separate contracts for those lots.

5. If you are willing to execute the Works you are requested to send or hand in the enclosed Tender together with all annexes, exclusively prepared in the English language, completed and signed by a duly authorized person, in a sealed envelope, not later than stated as submission date on the front page to/at

....

The Tender shall be submitted in double packing. The inner packing shall be sealed and labelled as follows:

TENDER FOR PN: ....
PROJECT NAME: ....

The period for submission of Tender shall expire with the date and time mentioned in the letter head. Tenders may be withdrawn by letter, telex, telegraph, or fax, prior to the submission time and date.

6. The period of adjudication begins with the submission/opening date and expires on the ....(date).......... The Tenderer is bound to his Tender until this date.

7. Your confirmation of the receipt of the tender documents would be appreciated. If you are not interested in submitting a Tender, please return the enclosures blank as soon as possible.

....
Employer or The Engineer/Consultant

9.7 Tender Conditions for Contractors (TENDRCON)

1. GENERAL

1.1 The Tender must comply with the following conditions and instructions. Failure to do so is liable to result in the rejection of the Tender.

1.2 "Tenderer" means any person or persons, partnership, firm or company being prequalified and submitting fully priced Bill of Quantities in accordance with the Tender.

1.3 All recipients of the Tender Documents shall, whether they submit a Tender or not, treat the details of these documents as confidential.

2. TENDER DOCUMENTS

2.1 The Tender must be made out on the forms provided in the Tender Documents duly completed in ink or in print. The Bill of Quantities must be fully priced, totalled, checked arithmetically, and the grand total must be in compliance with the sum entered in the Tender. Tender and Contract Documents must be kept intact.

The Tender Documents and accompanying documents shall be signed by the Tenderer or his legally authorized representative and be returned to the address according to No. 5 of the "Invitation to Tender".

2.2 The Tender must be accompanied by:

(a) A copy of each Circular Letter (see par.7) issued to Tenderers by the Employer or the Engineer (if applicable). Each copy of such Circular Letter must be endorsed by the Tenderer.

(b) The Form of Tender with Appendix to Tender (if applicable), and the Form of Bid Bond (if any), together with the Bill of Quantities, fully priced and summarized.

Any missing document may result in the rejection of the Tender.

2.3 Prices must be quoted for all items in the Bill of Quantities, where applicable, or a clear indication must be given that the values of the Works described under items left unpriced are allowed for elsewhere.

3. EXAMINATION OF SITE

3.1 Tenderers shall visit the site of the Works and obtain for themselves all information that may be necessary for completing their Tenders and for entering into a contract with the Employer. Tenderers shall aquaint themselves with the requirements of the contract, e.g. characteristics of the site and its surroundings, hydrological and climatic conditions.

In particular, Tenderers shall acquaint themselves with the conditions of

(a) existing access roads or other means of communication and access to the site of works, incl. police regulations concerned therewith,

(b) available land for storage, workshops, toilets, and site office(s),

(c) available connections to electricity and water for construction,

(d) the soil and subsoil to be excavated, stored or removed from site.

The availability of local labour, their quarters on site (if necessary), local materials and other local recources shall also be considered.

4. MODIFICATIONS/ADDITIONAL OFFERS

4.1 The Tender may contain only the prices and statements required in the Tender Documents and shall be signed by a duly authorized person. Any addition to, deletion or alteration of the Tender Documents may result in the rejection of the Tender.

4.2 Additional offers/proposals for modifications which, from the technical point of view, deviate from the Engineer's Specification or such which entail a demand for other conditions of payment, execution deadlines or price reserves, shall only be admitted in connection with the submission of the base Tender.

–

Proposals for modifications and additional offers shall be made in a separate annex and must be clearly marked as such.

Modifications by the Tenderer concerning prices quoted or statements made shall be unambiguous. Samples and patterns submitted with the Tender must be clearly marked as appertaining to the Tender.

5. PRICES

5.1 All prices (unit prices, lump sum prices, settlement rates, hourly wages, bonuses) shall be stated **without** tax (turnover tax, value added tax, or alike). The amount of applicable tax shall be based on the locally valid tax rate and shall be added as the last item on the summary sheet of the Tender.

5.2 The offer of a discount based on the observance of certain payment deadlines described by the Tenderer shall be taken into account in the evaluation only if the tenderer declares that such a discount shall apply to all payments on account and the final payment, providing that the deadlines set for payments leave reasonable time for their processing.

5.3 The Employer will not be held responsable if the local bank in the recipient country converts the payments to the Contractor into local currency before crediting the same to the Contractor's account. The Contractor is not entitled to claim for any charges or fees deducted by the bank due to the exchange and/or transfer of payments.

6. AMBIGUITIES

If, in the Tenderer's opinion, the Tender Documents contain ambiguities which might influence the calculation of the prices, the Tenderer shall indicate this to the Employer by letter, telefax, telex, or telegram before submitting his Tender within 30 days after the receipt of the Tender Documents. Necessary clarification will be made by Circular Letter(s).

7. CIRCULAR LETTER

7.1 In the event that the Employer sends Circular Letters to the Tenderers during the tendering period in order to comment, clarify, or modify the Contract Documents, these Circular Letters shall become an integral part of the Contract Documents and it shall be assumed that they have been taken into account by the Tenderers in drawing up their Tender.

7.2 The Tenderer shall confirm the receipt of a Circular Letter to the Employer immediately. No Circular Letter shall be dispatched within 21 days before the submission date for the Tender, except one that confirms a due postponement of the original submission date.

8. PROHIBITED AGREEMENTS

Agreements restricting the competition are not permitted, especially arrangements and negotiations with other Tenderers in respect of

- submitting or not submitting a tender,
- the prices to be demanded and profit rates,
- binding arrangements for other compensation,
- processing cost margins and other price components,
- terms of payment and delivery and other conditions of contract insofar as they influence the prices directly or indirectly,
- indemnity or compensation payments for non−participation or limited participation in the competition,
- and profit−sharing.

9. SUBCONTRACTORS

If parts of the Works are intended to be executed by subcontractor(s), the Tenderer shall indicate nature and scope of such parts of the works and state name and address of the subcontractor(s) considered.

10. JOINT VENTURES

Tenders submitted by Joint Ventures or other Bidding Combinations shall be accepted only if the following information is provided with the Tender

(a) A list of the members of the Joint Venture/Bidding Combination designating the duly authorized representative(s).

(b) A declaration, signed by duly authorized representatives of all members, stating that the duly authorized representatives shall represent the members specified in the list in a legally binding manner vis−a−vis the Employer, and that all members are jointly and severally liable for the performance of the Contract with the Employer.

11. SUBMISSION OF TENDER

11.1 The Tender shall be submitted to the address stated in and prior to the time and date specified in the Invitation to Tender.

11.2 Tenders received after the date and time of submission will not be considered.

12. OPENING OF TENDERS

12.1 Tenderers shall be free to attend the opening session of the Tenders.

12.2 The session shall be held for opening and reading out the Tenders. Until this session all Tenders received shall be kept under lock and key with the envelopes unopened and marked with the date of receipt only. For the Opening Session the following procedure shall be observed and laid down in the minutes of meeting, stating place, date and time of the opening:

(a) The chairman of proceedings shall establish whether the seals of the envelopes are intact.

(b) Samples and patterns submitted with any Tender shall be on hand and duly marked.

(c) The Tenders shall be opened one after another and all major parts marked. The names and addresses of the Tenderers and the final amounts of their Tenders or of individual sections as well as other particulars concerning the price shall be read out. It shall be announced if and by whom proposals for modifications and/or additional offers have been submitted. Other details of the contents shall not be made known.

(d) The minutes taken of the opening session shall be read out, shall contain a note to the effect that they have been read out aloud and that it has been acknowledged as correct or shall specify what objections have been raised by whom.

(e) The minutes shall be signed by the chairman of proceedings.

12.3 Tenders which were not received prior to the submission time and date shall be specified separately in the minutes or addendum thereto. The time of receipt and the reason for the delay of the receipt shall be noted. Envelopes and other means of proof shall be kept in safe custody.

12.4 The Tenderers and their authorized representatives shall be permitted to inspect the minutes of the opening session and addenda thereto (if any). The minutes of the opening session shall not be published.

13. EVALUATION OF TENDERS

13.1 The following Tenders shall be excluded:

(a) Tenders received after opening date and time.

(b) Tenders submitted by tenderers who have entered into an agreement which constitutes a prohibited restriction of competition.

13.2 In selecting the Tenders to be considered for the award of contract, only those Tenderers who offer the necessary security for the performance of the contractual obligations will be taken into account. This shall entail the necessary expertise and experience, performance capacity and capability, the reliability as well as technical and financial means and recources.

13.3 Tenders, of which the prices are obviously disproportionate to the Works concerned, will be disregarded. Only such Tenders from which proper execution and covering of the defect liability period can be expected with due regard to rational and thrifty construction operations and efficient management will be considered. From those Tenders the award will be made to the one which appears to be the most acceptable with regard to all technical, functional, environmental and economical aspects.

13.4 Any arithmetical error by the Tenderer in pricing the Bill of Quantities or in the additions or in carrying forward subtotals to the summary or to the Tender shall be corrected during the evaluation of the Tenders. In such cases the Tender sum shall be adjusted accordingly and the Tenderer shall be informed. It shall be assumed that the unit price rates entered in the Bill of Quantities are correct.

13.5 Proposals for modifications and additional offers which the Employer has admitted or requested for the tendering action shall be evaluated in the same way as the base tender. Other proposals for modifications and additional offers may be considered.

13.6 The Employer does neither bind himself to accept the lowest Tender or any Tender, nor will he be responsible or pay for expenses or losses which may be incurred by any Tenderer with the preparation of his Tender.

14. CANCELLATION OF THE TENDERING ACTION

14.1 The Tendering Action can be cancelled, if

(a) no Tender has been received which corresponds to the Tender Conditions,
(b) there have been substantial changes to the basis of the Tendering Action, or
(c) there are other serious reasons for such a cancellation.

14.2 The Tenderers shall be informed without delay of the cancellation of the Tendering Action by the Empoyer or his Engineer and of the reasons for the same.

9.8 Tender Form for contract above 1500,000 Euro (TENDRFID)

TENDER

Contractors stamp

Project No: ....

Project Title: ....

Contractor: ....

To	**or**	....
(Name and address of Employer)		*(Name and address of project office, embassy or consultant's office in the recipient country)*

Dear Sir or Madam,

1. Having examined the Conditions of Contract, Drawings, Specifications, Bill of Quantities and all other documents received with the Invitation to Tender for the execution of the Works in connection with the above named Project, we, the undersigned, offer to execute and complete such Works and remedy any faults and defects therein in conformity with the conditions spelled out in the aforementioned documents for the sum of

....

(in words ....)

or such other sums as may be ascertained in accordance with the said conditions.

2. We acknowledge that the Appendix to Tender enclosed forms part of our Tender.

3. We undertake, if our Tender is accepted, to commence the Works within the time required in the contract conditions, and to complete the whole of the Works comprised in the contract within the time stated in the Contract Conditions.

4. We agree to abide by this Tender for the period of 180 days from the submission/opening date stated in the Invitation to Tender and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

5. Unless and until a Contract Agreement is signed, this Tender, together with your written acceptance thereof, shall constitute a binding contract between us.

6. We understand that you are not bound to accept the lowest or any Tender you may receive.

Dated this : .... day of ....

Signature : .... in the capacity of.............................

duly authorized to sign Tenders for and on behalf of ....

....

....

(Contractors name and address in block capitals)

End.: APPENDIX TO TENDER

APPENDIX TO TENDER

	FIDIC–Part I Clause:	
Amount of Performance Security	**10.1**	................percent of the Contract Price
Time to submit Work Programme	**14.1**	.... days after signing the contract
Minimum amount of third party insurance	**23.2**	.... per occurance with number of occurances unlimited
Commencement of Works	**41.1**	....
Time for Completion of Works	**43.1**	.... days
Amount of Penalty for Delay	**47.1**	.... per day
Limit of Penalty	**47.1**	....
Defects Liability Period	**49.1**	.... months
Advance Payment	**60.12**	................percent of the Contract Price
Minimum amount of interim certificates	**60.2**	....
Percentage of Retention	**60.3**	................percent of the Contract Price

Spaces at Clauses 41.1, 43.1 and 60.12 above to be filled in by Tenderer!

Date .... Initials of signatory of Tender ....

9.9 Minutes of Opening Tender (MOPTENDR)

Project ....

MINUTES OF OPENING TENDER

Works ....

....

Date: .... Time: .... Place: ....

No.	Invited contractor	Representative present	Tender delivered	Tender signed	Tender complete	Total amount offered
1		Yes/No	Yes/No	Yes/No	Yes/No	I.
						II.
						III.
						Total
2		Yes/No	Yes/No	Yes/No	Yes/No	I.
						II.
						III.
						Total
3		Yes/No	Yes/No	Yes/No	Yes/No	I.
						II.
						III.
						Total
4		Yes/No	Yes/No	Yes/No	Yes/No	I.
						II.
						III.
						Total
5		Yes/No	Yes/No	Yes/No	Yes/No	I.
						II.
						III.
						Total
6		Yes/No	Yes/No	Yes/No	Yes/No	I.
						II.
						III.
						Total

Remarks:

....

....

Commission members **Signatures**

....

....

....

Project ....

PARTICIPANTS OF OPENING TENDER PROCEDURE

Works ....

....

Date: .... Time: .... Place: ....

No.	**Name**	**Company**	**Signature**
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

16

....

17

....

18

....

19

....

20

9.10 Contract for Construction Works on Measurement Basis (recommended for contract value up to 150.000 Euro) (CONCTRMB)

CONTRACT FOR CONSTRUCTION WORKS	Employer's logo
ON MEASUREMENT BASIS	
The	Date:
(Name and address of Employer)	*refer to in all correspondence:*
....	Contract No.:
....	
....	Project No.:
hereinafter referred to as the **– "Employer" –**	
and:	
(Name and address of Contractor)	
....	
....	
....	
hereinafter referred to as the **– "Contractor" –**	
herewith enter into the following Contract	

for the Project:	
Country:......................	

1. PURPOSE OF THE CONTRACT – SCOPE OF WORKS

The Employer awards and the Contractor takes over the execution of the following construction works:

2. CONTRACT DOCUMENTS

The priority of documents forming the Contract shall be as follows:

2.1 This Contract for Construction Works.

2.2 The Specifications

2.3 The Drawings enclosed to the Invitation to Tender, i.e.

No........... dated............. No............ dated................
No........... dated............. No............ dated................

and such drawings and details as may be issued by the Employer or his Authorized Representative for the clarification of the Works during execution.

2.4 The priced Bill of Quantities (including Daywork Rates), dated ....

3. TERMS OF EXECUTION – COMMENCEMENT OF WORKS

3.1 The Employer or his Authorized Representative shall give at least 7 days notice, in writing, prior to the date of handing–over of the site. The Contractor shall commence the Works within 5 days of the date of the handing–over of site.

3.2 The Contractor agrees to execute and to complete the Works as described in the documents listed under Clause 2 with due care and diligence in accordance with generally accepted construction practices.

3.3 The Contractor shall be obliged to observe the Laws, Bye–Laws, Ordinances and Statutes and other legal provisions of the country in which the Works are executed, in particular labour laws, local standards, public rules and regulations.

3.4 The Contractor shall submit a work programme not later than ...... weeks after the signing of this Contract.

3.5 The Contractor shall supply all building materials, equipment, plant and tools necessary for the execution of the Works in due number and time.

3.6 The Contractor shall provide all qualified and experienced labour necessary in due number and time and shall supervise their activities with due care and diligence. The Employer shall be entitled to object to and require the Contractor to remove from the Works any person employed by the Contractor who, in the opinion of the Employer, is incompetent, negligent, or guilty of misconduct.

3.7 No work shall be covered up or otherwise put out of view without prior approval in writing by the Employer or his Authorized Representative.

3.8 The Employer shall be entitled to make any variation of the form, quantity or quality of the Works or any part thereof that may, in his opinion, be necessary or desirable (cf. Clause 4.2). No such variation shall be made without an order in writing by the Employer or his Authorized Representative.

3.9 Building materials and Works may be subjected to tests at any time at the request of the Employer. These tests shall be carried out as directed by the Employer or his Authorized Representative at the place of manufacture or fabrication or on site or in a testing institute. The Contractor shall provide such assistance, materials, plant, instruments and labour as required for such test. The costs of carrying out such tests shall be borne by the Contractor.

3.10 The Contractor shall keep the site free from all unnecessary obstructions at all times and shall remove all materials and plant which are no longer required. Upon completion of the Works he shall leave the site clean and orderly to the satisfaction of the Employer or his Authorized Representative.

4. REMUNERATION – ADDITIONAL WORKS

4.1 The Employer shall pay the Contractor a Contract Price of up to

....
(in words...)

in accordance with the prices stated in the Bill of Quantities and the Works actually executed and measured. The Contract Price shall be subject to such additions and deductions as may be made under the provisions of this Contract.

4.2 The rates and prices of the Bill of Quantities shall cover all services and works of the Contractor described in the Specifications and the Drawings. Additional works shall be remunerated only if they were ordered in writing by the Employer or his Authorized Representative and shall be valued at the prices set out in the Bill of Quantities.

4.3 If the Contract does not contain any rates or prices applicable to the extra or additional work, then suitable rates or prices shall be agreed upon between the Employer and the Contractor. In the event of disagreement, the Employer shall fix such rates or prices as shall, in his opinion, be reasonable and proper, taking into account all prevailing circumstances.

4.4 The Contractor shall invoice turnover tax if and as prescribed by law; the Employer will refund the amount in addition to the remuneration.

Amount of turnover tax *(if applicable):* ....

5. TIME FOR COMPLETION – PENALTY FOR DELAY

5.1 The Contractor shall complete the Works as listed under Clause 1 and 2 within............ days after the handing–over of site and shall request the issue of the Taking–Over Certificate at least 3 weeks prior to the date of completion.

5.2 If the Contractor should fail to achieve the completion of the Works within the period prescribed in Clause 5.1, the Contractor shall pay to the Employer a penalty of one per mille (1/1000) of the Contract Price stated under Clause 4.1 for every day of delay up to a limit of 10 % of the Contract Price.

5.3 The payment of such penalty shall not relieve the Contractor from his obligation to complete the Works or from any other obligation or liability under this Contract.

6. AUTHORIZED REPRESENTATIVE – SUPERVISION OF THE WORKS

The site supervision shall be carried out by an authorized firm or person assigned to act on behalf of the Employer and shall exercise the rights of the Employer under this Contract. The Employer herewith appoints as Authorized Representative for the execution of the Works:

....
....

7. PAYMENTS

7.1 All payments shall be made in .... *(currency)*
to the following bank and account number of the Contractor:

....
....

7.2 The parties of this Contract agree to the following payment schedule:

7.2.1 Against presentation of a bank guarantee by a bank accepted by the Employer in compliance with the specimen enclosed (see GARANTAP) the Contractor shall receive an advance payment of.......% of the Contract Price =.......................

The advance payment shall be repaid by deduction of the corresponding percentage from each payment on account.

7.2.2 Payments on account shall be made in accordance with the progress of the Works measured on site each month, in keeping with the Bill of Quantities and after certification of each invoice by the Authorized Representative.

7.2.3 Each invoice shall be submitted in duplicate and bear the project and contract number indicated on the front page of this Contract.

7.2.4 An amount of 10 % of the total of each payment on account shall be withheld by the Employer as Retention Money.

7.2.5 After the issue of the Taking−Over Certificate (in compliance with TAKGOVER) and presentation of the final bill the remuneration due shall be paid reduced by 5 % of the total Contract Price, which shall be released after the defects liability period has expired, provided the Works are free of defects. This amount may be released against the provision of a Defects Liability Guarantee by a bank accepted by the Employer in compliance with the specimen enclosed (see GARANTDL).

8. TAKING−OVER CERTIFICATE − DEFECTS LIABILITY PERIOD

8.1 The Employer or his Authorized Representative shall issue the Taking−Over Certificate in compliance with the specimen enclosed (see TAKGOVER) within 3 weeks of the date of delivery of the Contractor's request for its issue, provided that the whole of the Works have been completed in accordance with the Contract and to the satisfaction of the Authorized Representative.

If the Works have been completed except for minor faults or missing items, the Employer or his Authorized Representative shall include a statement in the Taking−Over Certificate, listing all faults and defects, missing items or outstanding works to be completed, including the date when all rectification and finishing works shall be completed.

8.2 The Defects Liability Period shall be twelve (12) months, starting with the date of issue of the Taking−Over Certificate.

8.3 Defects, faults, or shrinkage due to the use of materials or workmanship not in accordance with the Contract and which arise during the defects liability periodshall be made good by the Contractor immediately after notification. For these rectifications a new defects liability period shall start on their day of completion.

8.4 If the Contractor should fail to comply with his obligations under this Contract, the Employer shall be entitled to either make a deduction, claim damages or, giving four (4) weeks notice to the Contractor, employ another contractor to execute the works required for rectification and to deduct all expenses arising thereon or incidental thereto from the moneys retained according to Clause 7.2.4 or 7.2.5, or to recover these from the Contractor.

9. LIABILITY− INSURANCE

9.1 The Contractor shall be liable for all damages caused by himself, his agents or persons employed or in any way engaged by him for the execution of the Works.

9.2 Subletting of the Works under this Contract or of any part thereof shall require the express written consent of the Employer. This approval may be revoked at any time in case serious complaints arise. The Contractor shall be liable for all services performed by his subcontractors in the same manner as for his own services.

9.3 Without limiting his obligations and responsibilities under this Contract, the Contractor shall insure himself at his own expense against his liability for any material or physical damage, loss or injury which may occur to any person or property arising out of or in consequence of the performance of this Contract.

9.4 The insurance sum shall be as customary in the country where the works are to be executed.

10. TERMINATION OF THE CONTRACT

10.1 The Employer may terminate this Contract at any time either wholly or in part for individual parts of the Works.

10.2 Should the Employer terminate the Contract for a reason for which the Contractor is answerable, the Employer shall be entitled to claim compensation for damages. In this case the Employer shall remunerate only the Works already completed, provided the Employer can use them. The Employer may offset the claim for damages against the remuneration. Any other legal rights of the Employer shall remain unaffected.

10.3 Should the Employer terminate the Contract for a reason for which the Contractor is not answerable, the Contractor shall be entitled to payment for work already completed and to reimbursement of unavoidable expenses incurred prior to the date of termination.

11. ARBITRATION

All disputes arising in connection with the present Contract shall be finally settled under the Rules of Arbitration of the International Chamber of Commerce by one or more arbitrators appointed in accordance with the said rules.

12. FINAL PROVISION

This Contract shall be modified or supplemented only by written agreement.

....	....
(Place, Date)	(Place, Date)
....	....
The Employer	The Contractor *(seal, if available)*

Annexes:

– Specimen Advance Payment Guarantee (GARANTAP)
– Specimen Defects Liability Guarantee (GARANTDL)
– Specimen Taking–Over Certificate (TAKGOVER)

9.11a Specimen of Performance Guarantee (GARANTPF)

<u>Performance Guarantee</u>

Employer/Beneficiary:	....
Consultant:	....
	....
Contract Date:	....
Contract No.:	....
Project No.:	....
Object of supply/performance/civil works*:	....
	....
	....

Contract price: *(Currency)* ....

We hereby undertake vis−a−vis the Employer to guarantee independently fulfilment of all of the Contractor's/Consultant's* obligations arising from the afore−mentioned contract, including any incidental claims, up to the amount of

(Currency) .... (... % of the Contract Price)
(in words: ....)

Explicitly waiving all objections and defences, we undertake to render said payment upon receipt of the beneficiary's first written demand, provided that the latter states that the Contractor/Consultant* has failed to observe all or part of his contractual obligations.

This guarantee shall become effective with the date of signing the contract and shall remain valid until the date of issue of the Taking−Over Certificate.

The Employer shall return this guarantee to us as soon as its validity expires.

This guarantee shall be governed by the law of...........(Country).............The place of jurisdiction for all disputes arising from this guarantee shall be...........(Town)...........

.............(Place)........, ...(Date).........

....

(Signature of the guarantor) * delete what is not applicable

9.11b Advance Payment Guarantee (GARANTAP)

<u>Advance Payment Guarantee</u>

Employer/Beneficiary:	....
Consultant:	....
	....
Contract Date:	....
Contract No.:	....
Project No.:	....
Object of services/performance/works*:	....
	....
	....
Advance payment pursuant to the contract:	*(Currency)* ....

We hereby undertake vis−a−vis the Employer to guarantee independently repayment of the advance payment stipulated above, including any incidental claims, up to the amount of

(Currency) .... (... % of the Contract Price)
(in words:...)

Explicitly waiving all objections and defences, we undertake to render said payment upon receipt of the Beneficiary's first written demand, provided that the latter states that the Consultant has failed to observe all or part of his contractual obligations.

This guarantee shall become effective with the first advance payment made by the Employer, shall decrease in proportion to the reduction of monthly payments, and shall expire when the advance payment has been repaid in full.

The Employer shall return this guarantee to us as soon as its validity expires.

This guarantee shall be governed by the law of............(Country).............The place of jurisdiction for all disputes arising from this guarantee shall be............(Town)............

.............(Place)........, ...(Date).........

....

(Signature of the guarantor) * delete what is not applicable

9.11c Guarantee for Defects Liability Period (GARANTDL)

<u>Defects Liability Guarantee</u>

Employer/Beneficiary:	....
Consultant:	....
	....
Contract Date:	....
Contract No.:	....
Project No.:	....
Object of services/performance/works*:	....
	....
	....
Contract price:	*(Currency)* ....

We hereby undertake to grant the Employer an independent guarantee for the warranty claims to which he is entitled vis−a−vis the Consultant pursuant to the afore−mentioned contract, including any incidental claims, up to the amount of

(Currency) .... (... % of the Contract Price)
(in words: ....)

Explicitly waiving all objections and defences, we undertake to render said payment upon receipt of the Beneficiary's first written demand, provided that the latter states that the Consultant* has failed to observe all or part of his contractual obligations.

This guarantee shall become effective upon the date of issue of the Taking−Over Certificate and shall expire upon the end of the Defects Liability Period.

The Employer shall return this guarantee to us as soon as its validity expires.

This guarantee shall be governed by the law of............(Country).............The place of jurisdiction for all disputes arising from this guarantee shall be............(Town)............

.............(Place)........, ...(Date).........

....

(Signature of the guarantor) * delete what is not applicable

9.12 Specimen of Construction Progress Report (PROGREP)

CONSTRUCTION PROGRESS REPORT No......	covering	....	....
		month	*year*

1. **Project Number** ....
   Name of Project ....
   Employer ....
2. **Architect/Consultant** ....
   Supervising Consultant ....
   Site Supervisor ....

3.	Start of construction period	scheduled	actual
	Anticipated date of completion		

4.	Meteorological (hurricane, flood, frost, earthquake) or local incidences (strike, emergency or martial law, or similar) which disrupted construction activities for more than three (3) consecutive days:

5.	Contractors/subcontractors working at site during reporting period:

6.	Labor force	Number of engineers	
	(monthly average)	Number of foremen	
		Number of skilled craftsmen	
		Number of unskilled workers	
		others	
		Total on site	

7.	Occurences/hinderances unexpected and unforeseen,

8.	**Progress of work** state the following data for each building/part of building or installation:

	item of work executed	percentage of completion	ahead or behind schedule
8.1			
8.2			
8.3			
8.4			
8.5			
8.6			
8.7			
8.8			
8.9			
8.10			
8.11			
8.12			
8.13			
8.14			
8.15			
8.16			
8.17			
8.18			
8.19			
8.20	Overall completion of project		

9.	Reasons for being behind schedule under Item No.:

10.	Steps taken to overcome lack of progress under above items:

11. compiled:

....

place date signature

12. Enclosures:

.... sheets with photos of the construction progress

9.13 Form of Certificate of Taking–Over (TAKGOVER)

Project No:	....	
Project Title:	....	
Contract No.:	....	dated:........................
incl. Supplement	dated	dated:........................
Contractor:	....	

TAKING – OVER CERTIFICATE

(In case of partial take–over precede title by "PARTIAL")

This is to certify that the Works of the subject contract incl. its supplement(s) have been completed to the satisfaction of the representatives named below and are being taken over as of

.... 20....

Following a joint inspection of the building(s)/installation(s) by the persons named below it has been ascertained that they have been carried out according to the Contract. Faults and defects and/or outstanding works have/have not been determined as listed on the attached sheet.

The following persons participated in the joint inspection as representative for

the Employer ....

the Engineer ....

the Contractor ....

(insert names in printed letters)

The faults and defects found and listed shall be eliminated and the outstanding Works/missing items (if any) shall be completed/installed without delay, definitely not later than

......................20....

All rights on the part of the Employer concerning liability and maintenance shall remain unaffected. The Employer reserves the right to avail himself of the contract penalty clause insofar as this has been agreed.

The execution of the Works has been commenced as of ....

With the building(s)/installation(s) completed and taken–over at the date stated above the **Defects Liability Period** commences at that same date and ends at....................

This Certificate shall be drawn up in three identical copies with one copy each for the three representatives signing below

....	....	....
Employer's Representative	Supervising Engineer	Contractor's Representative

End.: List of defects and/or outstanding works

ENCLOSURE TO TAKING–OVER CERTIFICATE

Project No:	....
Project Title:	....

Contract No.:	....	dated:........................
incl. Supplement	dated	dated:........................
Contractor:	....	

LIST OF DEFECTS AND/OR OUTSTANDING WORKS

1. The following faults and defects have been found and established during the joint inspection at the date of taking−over stated on the front page:

2. The following outstanding Works/missing items have been found and established during the joint inspection at the date of taking−over as above:

3. This **Partial Taking−Over Certificate** does not apply to the whole of the Contract stated above, but to the following parts/portions of work only:

....	....	....
Employer's Representative	Supervising Engineer	Contractor's Representative

9.14 Form of Certificate of Handing−Over (HNDGOVER)

This is to certify that the following works for the project named below have been completed to the full satisfaction of the representatives listed in the Minutes of the Handing−Over and are being handed over to and accepted by the authorized representative of the counterpart authority in the recipient country as of

Project No:	.... 20...........
Project Title:	....
Works:	....
	Remaining defects and outstanding works affecting the warranty of the contractor(s) have/have not been determined as stated in the **Minutes of Handing−Over** enclosed.

Upon this handing−over of the works all rights and obligations concerning the works are transferred to the counterpart authority in the recipient country.

The Project Agreement between the Government of the Federal Republic of Germany and the

Government of ....dated.................... shall remain unaffected and the works shall be at the unlimited disposition of the experts delegated by the GTZ to the promoted project for the implementation and completion of their duties and tasks.

....	....
Place	Date
Handed over by	Accepted by
....	....
Signature and name in printed letters of the authorized representative of the Employer	Signature and name in printed letters of the authorized representative of the counterpart authority

End.: Minutes of the Handing−Over

MINUTES OF THE HANDING−OVER

The handing−over of the

Works: ....

of

Project No: ....

with the

Project Title: ....

as of...................., 20..... has been accomplished by the following team of representatives present and authorized to sign for the:

	name in printed letters	*initial:*
Employer	....	....
Counterpart Authority	....	....
Usufructuary	....	....
German Embassy (if applicable)	....	....

Following a joint inspection of the works it has been ascertained that they have been completed as approved and are ready for use. Defects, deficiencies and outstanding works, all covered by contractors liability, were established as follows:

1. Faults and Defects at

1.1 Building/Installation

1.2. Exterior Facilities (if applicable)

2. Outstanding Works/Missing Items

2.1 Building/Installation

2.2 Exterior Facilities (if applicable)

3. Remarks:

With this certificate the following documents are handed−over to the authorized representative of the counterpart authority:

− one (1) set of as−built drawings,

− one (1) copy of the Taking−Over Certificate as of............20.....,

− one (1) copy of the Acceptance Certificate of the electrical installations and equipment, incl. the record of inspection,

− complete set of operating instructions and maintenance manuals for electrical/mechanical equipment (if applicable)

....	....
For the Employer	For the counterpart authority

9.15 FIDIC–Part I, Conditions of Contract for Works of Civil Engineering Construction (recommended for contract value above 150.000 Euro) Website Information (FIDIC–P1).

Information on FIDIC Publications (from Internet website "http://www.fidic.org")

FIDIC publishes:

- Information about FIDIC, with such booklets as FIDIC Info, a small information/address book published annually, and FIDIC Statutes and Bylaws.

- Information for clients, including the International Directory of Consulting Engineers (published every two years, and which is also available online at www.fidicdirect.com, Quality Based Selection, FIDIC Tendering Procedure and other valuable documents about the use of consulting engineers.

- Information for Consulting Engineers, with manuals/guides on topics such as risk management, environment, transfer of technology, quality management, dispute resolution techniques, insurance, law and other business issues.

Contracts/Agreement

The "backbone" of the body of FIDIC's publications is FIDIC's selection of contracts and agreements. FIDIC publishes Conditions of Contract for:

- Works of Civil Engineering Construction (The Red Book)
- Construction Contract (NEW: updates the Red Book)
- Electrical & Mechanical Works (The Yellow Book)
- Design–Build and Turnkey (The Orange Book)
- Plant and Design Build Contract (updates Yellow Book and Orange Book)
- EPC/Turnkey Projects
- The Short Form

These documents are available in printed and electronic versions, and a short text tells you how to choose the right contract.

All FIDIC contracts standard conditions of contract between a client/employer and a contractor. The consulting engineer is not a party to these contracts, but plays a role as the employer's representative to see that the contract is properly carried out.

Additionally, FIDIC publishes a Client/Consultant Model Services Agreement (The White Book), which is the agreement often used by the client when appointing a consultant as his employer's representative for the above contracts.

This "rainbow" of FIDIC contracts/agreements provides the major portion of the total income from publication sales to FIDIC.

FIDIC's volunteer committees, who draft nearly all of FIDIC's documents, are continuously drafting or revising, keeping FIDIC's Publications informative and up–to–date.

Representation Impact

Equally important for FIDIC is the representation/image impact of its publications. Most people first learn about the Federation by reading or using its business practice publications or standard conditions of contract. FIDIC's "quality image" is enhanced by its publication of quality documents.

The most pronounced example of this image impact is FIDIC's Conditions of Contract for Works of Civil Engineering Construction ("The Red Book", owing to its red cover), now in its fourth edition. Many people call the Red Book "FIDIC" or "the FIDIC", mistakenly using the Federation's acronym (taken from its original French name, Fédération Internationale des Ingénieurs–Conseils) for its best known publication, unaware of the Federation, but certainly aware of its Red Book.

This confusion is not surprising, when one considers that the Red Book is used as the general conditions in standard bidding documents of many development banks, including the World Bank.

Financial Impact

FIDIC's publications fulfil an important and essential role for the well being of the Federation. Revenues from publication sales account for nearly half of FIDIC's income, with most of the other half coming from Member Association (MA) subscriptions.

FIDIC's annual income from publications has grown from about SFr. 300,000.− in the late 1980's to more than SFr. 900,000.− today. This growth in publications sales has allowed FIDIC to reduce the unit rates for membership subscriptions by nearly one−half over the past decade, an important impact when one considers that more than half of FIDIC's Member Association's are in developing countries, many of which have weak currencies.

With FIDIC being a non−profit, self−supporting Federation, which neither seeks nor accepts financial support from any other body, the essential role played by its publications sales cannot be over emphasized.

Ordering

All FIDIC documents can be ordered online at the FIDIC.org Bookshop. The Bookshop gives details such as:

• Overview of contents.

• Translations: All FIDIC documents are published in English and depending upon the need, in other languages (but English remains the language of reference in case of legal dispute − see FIDIC Policy on Translations). However, other organizations often undertake to translate FIDIC documents, especially conditions of contract. The Bookshop indicates the translations that are available and where they can be obtained if they are not stocked by the Bookshop

• Prices: all prices are in Swiss francs and special offers are available for orders exceeding the minimum order provided more than three items are ordered.

International Federation of Consulting Engineers
FIDIC Bookshop− BP 86 • CH−1000 Lausanne 12 • Switzerland
Tel +41−21−654 44 15 • Fax +41−21−654 44 17• fidic.pub@fidic.org • FIDIC Bookshop

9.16 FIDIC−Part II, Conditions of Particular Application (as an example), drafted by the GTZ (FIDIC−P2), to be adapted to the specific project conditions.

CONDITIONS OF CONTRACT

PART II − CONDITIONS OF PARTICULAR APPLICATION

The following clauses of Part I of the "Conditions of Contract for Works of Civil Engineering Construction" (FIDIC), Fourth Edition 1987, reprinted with amendments 1992, prepared by the Fédération Internationale des Ingénieurs−Conseils, shall be supplemented, modified, deleted or added as follows:

Sub−Clause 1.1 − Definitions

(a) (i) The Employer is ....

....

....

....

....

(a) (iv) The Engineer is ....

....

....

....

....

The Employer is entitled to replace the Engineer at any time without the consent of the Contractor. In such a case the Employer shall notify the Contractor in writing without undue delay.

(b) (vi) “Letter of Acceptance”:

Sub−Paragraph (b) (vi) shall be added by the following:

“In case no Letter of Acceptance is issued all references to the Letter of Acceptance shall be deemed to be made to the Contract Agreement referred to in Sub−Clause 9.1.”

Sub−Clause 2.1 − Engineer’s Duties and Authority

Paragraph (b) of Sub−Clause 2.1 shall be amended as follows:

“(i) The Engineer shall obtain the specific approval of the Employer in writing before carrying out any of the following actions as specified in Part I:

(1) consenting to subcontracting of any part of the Works pursuant to Clause 4.1,

(2) determination of any extension of time pursuant to Clause 12.2 (a),

(3) determination of any additional costs pursuant to Clause 12.2 (b),

(4) issuing a Taking−Over Certificate pursuant to Clause 48.1,

(5) making any variation pursuant to Clause 51.1, unless the accumulated costs of the variations do not surpass ten (10) percent of the original Contract Price,

(6) fixing rates or prices pursuant to Clause 52, including provisional rates and prices,

(7) determining increased costs arising from special risks pursuant to Clause 65.5,

(8) determining any sums payable pursuant to Clause 65.8 in the event that the contract is being terminated.

(ii) Notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibilities under this Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Employer.”

Sub−Clause 2.2 − Engineer’s Representative

Sub−Clause 2.2 shall be deleted and substituted by:

"The Engineer's Representative shall be appointed by and be responsible to the Engineer. The Engineer's Representative shall either be a representative of the local representation of the Engineer or an expert seconded by the Engineer. Any appointment or revocation of the Engineer's Representative requires the specific written approval of the Employer and shall not take effect until a copy thereof has been delivered to the Contractor."

Sub–Clause 2.3 – Engineer's Authority to Delegate

Sub–Clause 2.3 shall be deleted and substituted by:

"Any communication given by the Engineer's Representative to the Contractor shall have the same effect as though it had been given by the Engineer."

Sub–Clause 2.4 – Appointment of Assistants

Sub–Clause 2.4 shall be deleted entirely.

Sub–Clause 2.5 – Instructions in Writing

In the last sentence the following words shall be deleted:

"and any assistants of the Engineer or the Engineer's Representative appointed pursuant to Sub–clause 2.4."

Sub–Clause 3.1 – Assignment of Contract

Sub–Clause 3.1 shall be deleted and substituted by the following:

"The Contractor shall not, without prior consent of the Employer (which consent shall be at the sole discretion of the Employer) assign the Contract or any part thereof or any benefit or interest therein or thereunder."

Sub–Clause 5.1 – Language and Law

(a) The language is English.

(b) The law is that in force in.................*(Country)*..................

Sub–Clause 5.2 – Priority of Contract Documents

The list of documents shall be deleted and substituted by the following:

(1) the Contract Agreement, if completed;
(2) the Letter of Acceptance, if issued;
(3) the Tender with Appendix;
(4) the Conditions of Contract Part II;
(5) the Conditions of Contract Part I;
(6) the Specifications;
(7) the Drawings; and
(8) the priced Bill of Quantities.

Sub–Clause 10.1 – Performance Security

The third phrase of Sub–Clause 10.1 shall be deleted and substituted by:

"Such security shall be in accordance with the specimen "Performance Guarantee" annexed to these Conditions."

Sub–Clause 10.3 – Claims under Performance Security

Sub–Clause 10.3 shall be deleted entirely.

Sub–Clause 13.1 – Works to be in Accordance with Contract

The last phrase of Sub−Clause 13.1 shall be deleted and substituted by:

"The Contractor shall take instructions only from the Engineer or, subject to the provisions of Clause 2, from the Engineer's Representative."

Sub−Clause 14.1 − Programme to be Submitted

The words "in Part II of these Conditions after the date of the Letter of Acceptance" in the first and second line shall be substituted by "in the Appendix to the Tender".

Sub−Clause 14.3 − Cash Flow Estimate to be Submitted

Sub−Clause 14.3 shall be deleted entirely.

After Sub−Clause 15.1 − Contractor's Superintendent

The following Sub−Clause 15.2 shall be added:

"15.2 − Language Ability of Contractor's Representative

The Contractor's representative shall have command of the contract language according to Sub−Clause 5.1 (a)."

Sub−Clause 20.4 − Employer's Risks

The definition of Sub−Clause 20.4 shall be preceded by the paragraph:

"The Employer's risks are limited to those related to the country where the Permanent Works are to be executed. The present political situation is well known to both parties and shall not be considered an Employer's risk; thus it shall not justify any claim, additional payment or any extension of time."

Sub−Clause 21.1 − Insurance of Works and Contractors Equipment

The following phrase shall be added to Paragraph (a):

",it being understood that such insurance shall provide for compensation payable in those types and proportions of currencies required to rectify the loss or damage incurred."

Sub−Clause 21.2 − Scope of Cover

The words "from the start of work at the Site" in Paragraph (a) shall be deleted and substituted by: "from the date fixed for the Commencement of Works under Sub−Clause 41.1".

After Sub−Clause 25.4 − Compliance with Policy Conditions

The following Sub−Clause 25.5 shall be added:

"25.5 − Source of Insurance

The Contractor shall be entitled to place all insurance relating to the Contract (including, but not limited to, the insurance referred to in Clauses 21, 23 and 24) with insurers approved by the Employer."

After Sub−Clause 26.1 − Compliance with Statutes. Regulations

The following Sub−Clauses 26.2 and 26.3 shall be added:

"26.2 − Agreements between.......................and the recipient country

The works under this Contract shall be carried out observing the Bilateral Agreement for Technical Co−operation and the Project Agreement between ....and the recipient country. These agreements provide inter alia that the import of equipment and materials required for the Contract Works will be free of any custom duties, taxes, or any other official charges.

26.3 – Violation of Agreements

Each and every case of violation of the aforementioned Agreements shall be reported by the Contractor to the Employer immediately."

Sub–Clause 30.3 – Transport of Materials or Plant

Sub–Clause 30.3 shall be deleted entirely.

After Sub–Clause 34.1 – Engagement of Staff and Labour

The following Sub–Clauses 34.2 to 34.5 shall be added:

"34.2 – Health and Safety

Due precautions shall be taken by the Contractor at his own cost to ensure the health and safety of his staff and labour in collaboration with and to the pertaining requirements of the local health authorities, labour laws, welfare and hygiene requirements.

34.3 – Alcoholic Liquor or Drugs

The Contractor shall not, otherwise than in accordance with the Statutes, Ordinances and Government Regulations or Orders for the time being in force, import, sell, give, barter, or otherwise dispose of any alcoholic liquor and/or drugs, or permit or suffer by his Subcontractors, agents, staff or labour to do so.

34.4 – Arms and Ammunition

The Contractor shall not give, barter, or otherwise dispose of to any person or persons, any arms or ammunition of any kind or permit or suffer the same as aforesaid.

34.5 – Disorderly Conduct

The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous, or disorderly conduct by or amongst his staff and labour and for the preservation of peace and protection of persons and property in the neighbourhood of the Works against the same."

Sub–Clause 36.2 – Cost of Samples

A full stop shall be inserted after "at his own cost" and the remainder of the sentence shall be deleted.

Sub–Clause 41.1 – Commencement of Works

The first sentence of Sub–Clause 41.1 shall be deleted and substituted by:

"The Contractor shall commence the Works on the date stated in the Appendix to Tender."

Sub–Clause 42.1 – Possession of Site and Access Thereto

In the third line of Paragraph (b) the words "with the Engineer's notice to commence the Works," shall be substituted by "upon the contractually agreed date of commencement of the Works,"

Sub–Clause 44.2 – Contractor to Provide Notification and Detailed Particulars

In the first line of the Paragraph (b) the words "or such other reasonable time as may be agreed by the Engineer," shall be deleted.

Sub–Clause 47.1 – Liquidated Damages for Delay

The Sub–Clause 47.1 shall be deleted and substituted by:

"47.1 – Penalty

If the Contractor fails to comply with the Time for Completion in accordance with Clause 48 for the whole of the Works or, if applicable, any Section within the relevant time prescribed by Clause 43.1, then the Contractor shall pay to the Employer the relevant sum stated in the Appendix to Tender as a penalty for every day which shall elapse between the relevant Time for Completion and the date stated in the Taking–Over Certificate of the whole of the Works or the relevant Section, subject to the applicable limit stated in the Appendix to Tender. The Employer may, without prejudice to any other method of recovery, deduct the amount of such penalty from any monies due to or to become due to the Contractor. The payment or deduction of such penalty shall not relieve the Contractor from his obligations to complete the Works, or from any other of his obligations and liabilities under this Contract, namely for damages caused by delay."

Sub–Clause 47.2 – Reduction of Liquidated Damages

The Sub–Clause 47.2 shall be deleted and substituted by:

"47.2 – Reduction of Penalty

If, before the Time of Completion of the whole of the Works or, if applicable, any Section, a Taking–Over Certificate has been issued for any part of the Works or for a Section, the penalty for delay in completion of the remainder of the Works or of that Section shall, for any period of delay after the date stated in such Taking–Over Certificate, and in absence of alternative provisions in the Contract, be reduced in the proportion which the value of the part so certified bears to the value of the whole of the Works or Section, as applicable. The provisions of this Sub–Clause shall apply to the rate of penalties only and shall not affect the limit thereof."

Sub–Clause 48.1– Taking–Over Certificate

Sub–Clause 48.1 shall be preceded by the following sentence:

"The Taking–Over–Certificate shall be issued by the Employer unless he authorises the Engineer in writing to issue such a Certificate."

After Sub–Clause 49.4 – Contractor's Failure to Carry Out Instructions

The following Sub–Clauses 49.5 to 49.7 shall be added:

"49.5 – No Engineer under contract

In case that there is no Engineer under contract during the defects liability period, the Employer shall assume all functions of the Engineer referred to in Clauses 49 and 50.

49.6 – Limitation of action

The Employer's right to demand that the Contractor make good any defect after notification thereof shall become statute–barred two years after that notification.

49.7 – Defects liability period for subsequent improvement works

In respect of the Works undertaken to make good defects, the defects liability period shall begin anew on the day on which those works have been acceptably completed. A certificate pursuant to Sub–Clause 48.1 shall establish that the Work has been completed in proper form."

Sub–Clause 52.2 – Power of the Engineer to Fix Rates

After the first full paragraph the following paragraph shall be added:

"Provided further that no change in the rate or price for any item contained in the Contract shall be considered unless such item accounts for an amount of more than two (2) percent of the Contract Price and the actual quantity of work executed under the item exceeds or underruns the quantity stated in the Bill of Quantities by more than 25 percent."

Sub–Clause 53.2 – Contemporary Records

The word “necessarily” in the third line shall be deleted.

Sub−Clause 53.3 – Substantion of Claims

The words “, or such other reasonable time as may be agreed by the Engineer” shall be deleted.

Sub−Clause 53.4 – Failure to Comply

Sub−Clause 53.4 shall be deleted and substituted by:

“If the Contractor fails to comply with any of the provisions of this Clause in respect of any claim which he seeks to make, he shall not be entitled to any payment in respect thereof.”

Sub−Clause 60.1 – Monthly Statements

At the end of the first line the number “six” shall be substituted by “two” and Paragraph (c) shall be deleted entirely.

Sub−Clause 60.2 – Monthly Payments

In Paragraph (b), within the first line, the phrase”, other than pursuant to Clause 47,” shall be deleted.

Sub−Clause 60.3 – Payment of Retention Money

The following Paragraph (c) shall be added:

> (c) The Employer shall pay the other half of the Retention Money mentioned in Paragraph (b) before the expiration of the Defects Liability Period for the Works against presentation of a Defects Liability Guarantee conforming with the annexed specimen and issued by a bank approved by the Employer.

Sub−Clause 60.6 – Final Statement

Sub−Clause 60.6 shall be deleted and substituted by:

“The Statement at Completion shall be deemed as the Final Statement.”

Sub−Clause 60.7 – Discharge

Sub−Clause 60.7 shall be deleted entirely.

Sub−Clause 60.8 – Final Payment Certificate

The number “28” shall be substituted by “56” and the words “, and the written discharge” in the first line, “finally” in the first line of Paragraph (a) and “, other than under Clause 47” in the second line of Paragraph (b) shall be deleted.

Sub−Clause 60.9 – Cessation of Employer’s Liability

A full stop shall be inserted after “Final Statement” and the rest of the sentence be deleted.

Sub−Clause 60.10 – Time for Payment

The Sub−Clause 60.10 shall be deleted and substituted by:

> “Any amount due to the Contractor shall be paid by the Employer to the Contractor within 45 days after receipt of an Interim Payment Certificate or the Final Certificate issued by the Engineer.”

After Sub−Clause 60.10 – Time for Payment

The following Sub–Clauses 60.11 and 60.12 shall be added:

"60.11 – Place of Payments

The place of performance for all payments shall be.."

60.12 – Advance Payment

An advance payment according to the amount stated in the Appendix to Tender shall be made by the Employer against the provision of an Advance Payment Guarantee by the Contractor according to the specimen annexed to these conditions. The bank providing such guarantee shall be subject to the Employer's approval.

The advance payment shall be written down by the Contractor by way of proportional reductions in any interim certificate and the Final Certificate, until the amount paid in advance has been written down to nought. The proportion of each reduction shall correspond to the relation of the advance payment to the total Contract Price."

Sub–Clauses 61.1. 62.1 and 62.2

Sub–Clauses 61.1, 62.1, and 62.2 shall be deleted entirely and substituted by:

"61.1 – Completion of the Contract

A Defects Liability Certificate shall not be issued. The Contract shall be considered as completed in full as soon as the Defects Liability Period has passed without any notice of defects or as soon as any works instructed pursuant to Clause 49 and 50 have been completed to the satisfaction of the Employer. The Defects Liability Guarantee shall be returned accordingly, if applicable."

Sub–Clause 65.7 – Removal of Contractor's Equipment on Termination

After the words "Sub–Clause 65.6," the words "or Sub–Clause 65.9" shall be added.

After Sub–Clause 65.8 – Payment if Contract Terminated

The following Sub–Clause 65.9 shall be added:

"65.9 – Termination of Contract at Employer's Convenience

The Employer shall be entitled to terminate this Contract at any time at his convenience by giving notice to the Contractor, with a copy to the Engineer. Such termination shall have immediate effect unless otherwise stated in said notice. In the event of such a termination, the Contractor shall

(a) proceed as provided under Sub–Clause 65.7, and
(b) be paid by the Employer as provided under Sub–Clause 65.8."

After Sub–Clause 66.1 – Payment in Event of Release from Performance

The following Sub–Clause 66.2 shall be added:

"66.2 – Partial Impossibility

If such circumstances as mentioned in Sub–Clause 66.1 render it impossible or unlawful for the Contractor to fulfil part of his obligations, Sub–Clause 66.1 shall apply mutatis mutandis. In such a case the Employer shall be entitled to terminate the Contract if he does not have an interest anymore in the fulfilment of the part not affected by such circumstances, but shall pay the Contractor according to Sub–Clause 65.8."

Sub–Clause 69.1 – Default of Employer

Paragraph (b) shall be deleted and the following phrase shall be added at the end of the Sub–Clause:

"A termination under Paragraph (a) requires a prior written reminder of the payment due, giving a reasonable time limit."

Sub–Clause 69.3 – Payment on Termination

The following sentences shall be added at the end:

"In any case, such payment shall be limited to the total Contract Price. However, the Contractor is obliged to take all necessary steps to minimise the damage."

Sub–Clause 69.4 – Contractor's Entitlement to Suspend Work

The words "to interest under Sub–Clause 60.10 and" shall be deleted and the following paragraph shall be added after the first full paragraph:

"However, any suspension of work or reduction of rate of work requires a prior written reminder of the payment due, giving a reasonable time limit."

Clause 70 – Changes in Cost and Legislation

The Sub–Clauses 70.1 and 70.2 shall be deleted entirely and substituted by:

"70.1 – Fixed Prices

The Contract Prices are fixed prices for the term of this Contract and shall not be subject to any adjustment in respect of rise or fall in the cost of labour, materials, or any other matters affecting the costs for the execution of this Contract."

Sub–Clause 71.1 – Currency Restrictions

The Sub–Clause 71.1 shall be deleted entirely.

Sub–Clause 72.2 – Currency Proportions

The whole text following the word "shall," (fifth line) shall be deleted and substituted by: "be as stated in the Appendix to Tender."

After Clause 72.3 – Currencies of Payment for Provisional Sums

The following Clauses shall be added:

"Clause 73.1 – Bribery and Agreements to Restrain Competition

If the Contractor or any of his sub–contractors, agents, or servants offer to give or agree to or give to any person any bribe, gift, gratuity, or commission as an inducement or reward for doing or forbearing to do any action in relation to the Contract or any other contract with the Employer or for showing or forbearing to show favour or disfavour to any person in relation to the Contract or any other contract with the Employer, then the Employer may enter upon the Site and the Works and terminate the employment of the Contractor and the provisions of Clause 63 thereof shall apply as if such entry and termination had been made pursuant to that clause. The same shall apply if the Contractor has taken part in agreements to restrain competition in order to obtain the contract or if he has made incorrect statements in the Tender Documents."

Clause 74.1 – Details to be Confidential

The Contractor shall treat the details of this Contract as private and confidential, save in so far as may be necessary for the purpose thereof, and shall not publish or disclose the same or any particulars thereof in any trade or technical paper or elsewhere without the prior consent in writing of the Employer. If any dispute arises as to the necessity of any publication or disclosure for the purpose of the Contract the same shall be referred to the decision of the Employer whose award shall be final."

Clause 75.1 – Joint and Several Liability

If the Contractor is represented by a joint venture of two or more persons, all such persons shall be jointly and severally bound to the Employer for the fulfilment of the terms of the Contract and shall designate one of such persons to act as leader with the authority to bind the joint venture. The composition or the constitution of the joint venture shall not be altered without the prior written consent of the Employer."

Clause 76.1 – Invalidity

The invalidity of one or several provisions of the Contract shall not affect the validity of the remaining provisions. Invalid provisions shall be substituted by such provisions as are closest to the economic purpose aimed at by both contracting parties."

10. Glossary

Backstopping

Accompanying professional and technical support.

Cash for Work

Remuneration for work (minimum wage level), in order to strengthen the buying power of many households. It is closely linked to "food–for–work", an instrument of food security with the aim of alleviating acute nutritional deficits, mobilising self–help and enhancing nutritional support activities. It is frequently applied in integrated food security programmes (IFSP), which, depending on the situation, can be a combination of food– and cash–for–work, operational inputs–for–work and equipment–for–work, as well as foodstuffs for participating in training programmes (food–for–training).

Conflicts

Conflicts are a common component of world politics, as well as of the politics within communities and states. They result from real or supposed contrasting interests. When two or more actors actively propagate their contradicting interests a conflict develops. Conflicts are usually local or regional, and rarely affect an entire country.

Conflict management

is the attempt to influence the course of a conflict by regulation, prevention of violence and finding a means of settlement. It aims at bringing about constructive solutions from which all parties can benefit.

Contract for construction works on measurement basis

A contract based on specifications of building works subdivided into individual works with agreed unit prices. Accounts are settled according to actual measurements and quantities of the materials used and work accomplished (in contrast to a lump sum contract).

Crisis prevention

incorporates early, planned, systematic and coherent action at different levels of state and society in order to prevent violent conflicts. Activities conceived to prevent crises aim to reduce the potential for increased violence, before, during or after a violent conflict, and to promote the development of institutions, structures and "cultures" to settle disputes with peaceful means.

Development–oriented emergency aid

Development–oriented emergency aid (DEA) encompasses all measures, initiatives and reactions to emergency situations in crises, conflicts and disasters and their prevention. The aim is to contribute to a reduction of the endangering and vulnerability of people – at household level, as well as regional and national levels – or to alleviate the effects of disasters: either by precautionary measures to avoid or by managing existing emergency situations.

Disaster

A disaster is an disruption in the normal functioning of a society, which leads to loss of human lives, property and environmental resources, and which exceeds the ability of the affected communities to cope using only its own resources. There are three types of disasters: man−made disasters (caused by technological failures), natural disasters and conflicts. They can occur suddenly, over a certain period of time, or exist permanently.

Disaster risk assessment

This means the recording of disaster risks (potential threat, including statistical frequency of hazards) in a given region over a given period of time. The aim is to assess the probability of occurrences, the estimation of potential losses (number of dead and injured, damage of property, interruption of economic activity) and a disaster alleviating information system and evaluation (e.g. demarcation of endangered areas, establishment of early warning systems).

Disaster risk management

Disaster risk management includes measures to avoid disasters and to reduce the effects of disasters.

FIDIC

The FIDIC selection of contracts and agreements contain internationally accepted contract conditions and guidelines for the execution of building works worldwide. They are published by "Fédération Internationale des Ingénieurs−Conseils (FIDIC)" in two parts. Part 1 contains the general conditions, while Part 2 is concerned with the special clauses of the project and therefore has to be adapted to the specific conditions of the project in question. Further information and order forms can be found in the Internet under "www.fidic.net".

Financial cooperation

Financial Cooperation (FC; formally known as "capital aid") is an instrument of bilateral development cooperation. Its task is to provide capital which will make better use of, or boost, the production potential of developing countries, including their economic and social infrastructure. Through FC, funds are made available to partner countries in the form of soft loans or non−repayable financial contributions. Emphasis is on investment, not on advisory services. Unlike TC, FC is thus a means of financing and not a direct contribution. The Kreditanstalt für Wiederaufbau (KfW) is responsible for handling German Financial Cooperation on behalf of the Federal German Government.

Financing agreement (GTZ)

Financing agreements are agreements based on international law to provide a project of a partner with non−repayable, tied contributions of the GTZ from funds of the Federal German Government. Financial contributions are not direct contributions. They are provided where there is a competent local executing agency which is in a position to assume full responsibility for the proper planning and implementation of the project. Construction work, for instance, is usually supported through financial contributions. To handle a financial contribution, the GTZ enters into a financing agreement with the partner.

General contractor

Unlike the non−commercial general contractor (NGC), the general contractor carries out considerable parts of the works with his own resources (e.g. in his capacity as building contractor, construction of the building carcass) and sub−contracts other works to third parties.

Housing development

The housing development referred to here is concerned with temporary buildings and settlements with technical services and social facilities of varying standards. Depending on the standard of finish, level of investment and regional plans, the aim should be to achieve a certain degree of sustainability, such that, when the buildings are dismantled, at least a part of the technical systems (sewage, water supply, power supply, roads, or parts of them) can be reused in the case of a new development.

Immediate relief

Relief measures, that are implemented directly after a disaster or war, are called immediate relief. This immediate relief serves to ensure the instantaneous survival of the affected population.

Involvement/Participation

In development cooperation the term “participation” refers to the process, in which various actors share and negotiate control over development initiatives, and the decisions and resources associated with them. Participation as a management principle is based on the now widely acknowledged insight that processes of change are all the more successful, the more intensively the actors are appropriately involved in the design of project objectives and measures. Depending on the project type and phase, different degrees of participation may be appropriate.

Lump sum contract

A fixed price (or lump sum) is based on specifications of services to be rendered, for which a “fixed” price, i.e. an unalterable price, has been agreed. The “fixed” price necessitates a precise description of services and/or plans and drawings of a building project, which may be deviated from only marginally during execution. In the case of major deviations the additional costs have to be negotiated, or new services have to be paid for.

Non−commercial general contractor (NGC)

The NGC or implementing consultant “takes over” the responsibility for achieving the objectives of a project and is answerable to the financing agency for the services as a whole. He is less concerned with “undertaking” the professional implementation himself, but instead sub−contracts these services to professionals of the local or international building industry.

Nucleus model

In the case of a nucleus model, only the central core of a house, or only the main and essential rooms, installations and building components are constructed or repaired. All the rest is carried out by the owner at his/her own cost.

Ownership

The term “ownership” is used in today’s development policy debate to designate identification with the project, along with the motivation to assume responsibility for development initiatives and processes of change. It is also used to remind people of the subsidiarity of external support. Today, ownership in the above sense is considered an important precondition for the efficiency and sustainability of development processes, and in TC is one of the key quality indicators. It should be ensured that “ownership” exists, or is achieved in the course of a project, both within the partner organisation(s) and among the target groups and their institutions.

Project executing organisation

The project executing organisation is the legal entity responsible for human resources, financial and technical aspects of implementing a TC−supported project in the partner country. It may be state−run, parastatal or non−governmental. A project may imply cooperation with several project executing agencies, each with clearly defined responsibilities for specific components of implementation (responsibility for implementation) which do not overlap. In some cases the project executing organisation can engage third parties (private companies, institutions, groups or individuals) to provide the services agreed upon.

Project management

Action and responsibility for a technically and commercially/economically immaculate execution and accounting of a (building) project.

Rapid assessment

Investigations of one or more experts on location to determine the possibility of implementation and conception of a project from a technical point of view, taking into consideration the different requirements of the parties involved, and estimation of the time frame and costs.

Rehabilitation and reconstruction

The term rehabilitation includes measures that are taken up after a disaster, quite often directly after a phase of humanitarian aid and before the period of reconstruction, in order to restore existential social functions, which are needed to provide the basis for the ensurance of survival of the people with their own human and material resources.

Reconstruction leads to the complete restoration of a functioning society, economy and environment. In the process, the aim should be to regain the quality of life, or even exceed it, in comparison to the living conditions before the disaster. This should happen with regard to preventive measures against future risk situations.

Self−help

Self−help means people endeavouring to achieve goals through their own efforts. It is an individual or collective response to objective emergencies, or to situations perceived to be unsatisfactory, which people seek to overcome by sustainably improving their living conditions and increasing their self−reliance. Self−help efforts can involve changing a material situation or influencing political and social framework conditions. Help towards self−help is characterised by the following principles:

- The beneficiaries' own efforts are not substituted and the promoted individuals and groups are not exonorated from responsibility.

- Existing initiatives are strengthened; external promotion may not go beyond providing initial stimulus.

- The participation of affected persons and groups in all decision−making within the scope of the cooperation is a necessary precondition.

- Promotion is geared primarily to groups.

- The decision as to what constitutes the maximum possible self−help and the minimum necessary external support is the subject of dialogue with the beneficiary individuals or groups. In emergencies, it is displaced in favour of external aid, such that the proportion of self−help is reduced accordingly.

Significance

Does the project generate broad−based sectoral and/or regional impacts, can it be used as a model, and is it replicable in other sectors or countries? Does it contribute to institution−building and/or institutional development of the relevant sub−systems? The opposite of significant projects are so−called "island" projects, i.e. isolated projects which do not impact significantly on their wider environment.

Sustainability

This denotes a balance between the needs of the present generation and the living perspectives of future generations. With reference to projects, it describes the extent to which the partner organisations and target groups are willing and able to self−reliantly continue and further develop the innovations effected by the project. As a decisive quality criterion, sustainability presupposes in particular that

- the partner organisations designated to implement the project have the required qualifications,

- the effects of the project correspond with the needs of the target group,

- the services expected from the partners lie within their capabilities and

- the implementation is also justified under economic aspects.

Technical cooperation

The goal of technical cooperation is to enable people and organisations in partner countries to improve their living conditions on their own responsibility and through their own efforts. To this end, technical, economic and organisational skills and expertise are transferred within the scope of TC. Technical cooperation projects are implemented free of charge.

VOB − German contracting rules for award of public works contracts

The VOB is published by DIN (German Standards Institute) on behalf of the German Committee for the Award of Public Works Contracts. It comprises three parts:

- VOB Part A: General conditions for the award of contracts for building works;
- VOB Part B: General contract conditions for the execution of building works. These are general terms of business, which supplement the works contract law of the BGB (German Civil Code) with the necessary conditions specific to building works;
- VOB Part C: General technical contract conditions for building works.

Vulnerability

The vulnerability of a society is determined by such circumstances and influencing factors, that cause the existing resources and potentials of societies, population groups and individuals to be inadequate for the solution of problem situations by their own means, thus making them unable to prevent the occurrence of a disaster. The degree of vulnerability determines the degree of damage that results from a disaster. The basic cause of vulnerability can lie in socio−economic, political and ecological instability, or a combination of these factors.

Warranty

is the guarantee for a faultlessly executed piece of work continuously over a fixed period of time. In the case of building measures in emergencies, the warranty period should, depending on the situation, cover at least one year, or better still two years. In Germany it has recently been extended to 5 years for building projects.

11. Abbreviations

AA	Federal Foreign Office
BMZ	Federal Ministry for Economic Cooperation and Development
ECHO	European Community Humanitarian Office
EU	European Union
DC	Development cooperation
DEA	Development−oriented emergency aid
FA	Financing agreement
FC	Financial cooperation
FIDIC	Fédération Internationale des Ingénieurs−Conseils
GO	Government organisation
GTZ	German Technical Cooperation
HOAI	German fee scale for architects and engineers
IFRC	International Federation of Red Cross and Red Cresent
KfW	(Kreditanstalt für Wiederaufbau) The German Development Bank
NGC	Non−commercial general contractor
NGO	Non−governmental organisation

O + R (GTZ−internal) orientations and rules

OCHA United Nations Office for the Coordination of Humanitarian Affairs

SWIFT Money transfer system within the
"Society for Worldwide Inter−bank Financial Telecommunication"

THW German Federal Agency for Technical Relief

TOR Terms of reference

TC Technical cooperation

UN United Nations

UNDP United Nations Development Programme

UNHCR United Nations High Commission for Refugees

VOB German contracting rules for award of public works contracts

WFP World Food Programme