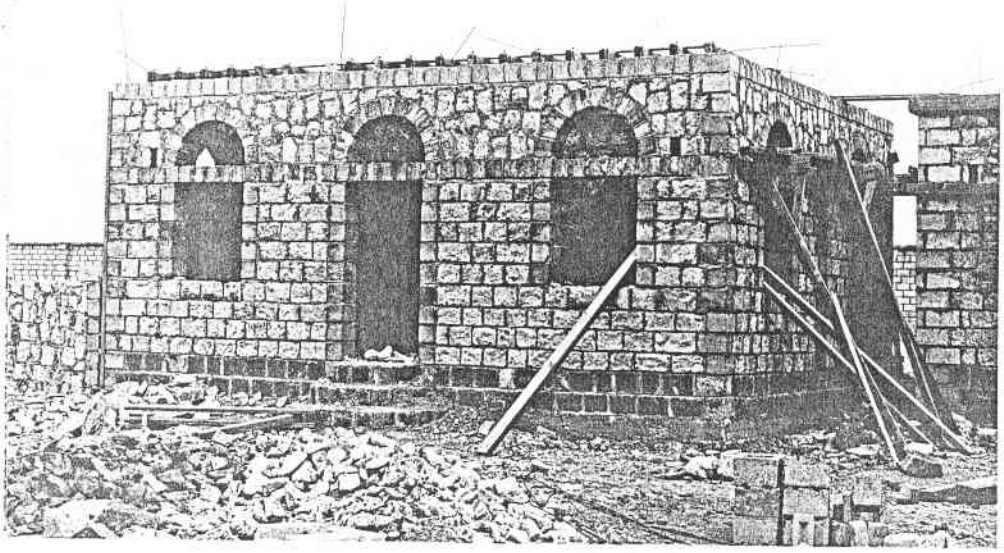
Yemen Arab Republic

Kingdom of the Netherlands
Commission of European Communities

Dhamar Aided Self Help Reconstruction Project

SUBJ: VISUAL REGISTRATION OF THE BUILDING OF THE STAFF HOUSES PLANNING ACTIVITY NO 50.



Sanaa 29 JULY 1984 Ing. Sjoerd Nienhuys

DHV

DHV Consulting Engineers

مهندسون استشاريون

Diskette: 650.NYN.ORG
DHAMAR AIDED SELF HELP RECONSTRUCTION PROJECT
FILE: 3.4160.62.03
DATE: 29 JULY 1984
SUBJ: VISUAL REGISTRATION OF THE BUILDING OF THE STAFF HOUSES PLANNING ACTIVITY NO 50. (addition to house construction 1)

INTRODUCTION

The visual registration of the building process is a means to save technical information about that building process, which will not be visuable after the building has been completed. This includes both those elements which are incorporated into the walls or in the foundation as well as the special building aids applied to achieve the obtained result.

This report has also the function of an evaluation of the chosen techniques and for that purpose it tends to be rather critical.

The building process which was practiced with the construction of the staff houses was a mixture of Yemeni common practice, introduction of alternative building methods and some experimenting as well.

Many of the remarks given in this report are already processed with the design of the Building Advice Centers and the Model houses in the project area.
Project activity no 81. is the visual registration of the building of the BAC's. This registration will be done mainly by slides and pictures, whilst the visual registration of the self-help houses will be probably done on video.
It is suggested to do the visual registration of the construction of the prefabricated office buildings also on video (VHS system).

The foundation construction is shown in chapter 1.
Three different houses were realized;
Chapter 2 shows the cement block house,
Chapter 3 shows the stone house with cement block corners.
Chapter 4 shows the stone house with U block corners.
Chapter 5 shows the production of the U blocks.
Chapter 6 is a brief cost comparization of the different houses as executed. The review of those final costs are given in the annex.

1.Foundation.
1.1. Tracing of the foundation.

Over the total construction area a grid system was laid, along which the different houses were coordinated. This grid was established with a double pentagon prism and a measuring tape.

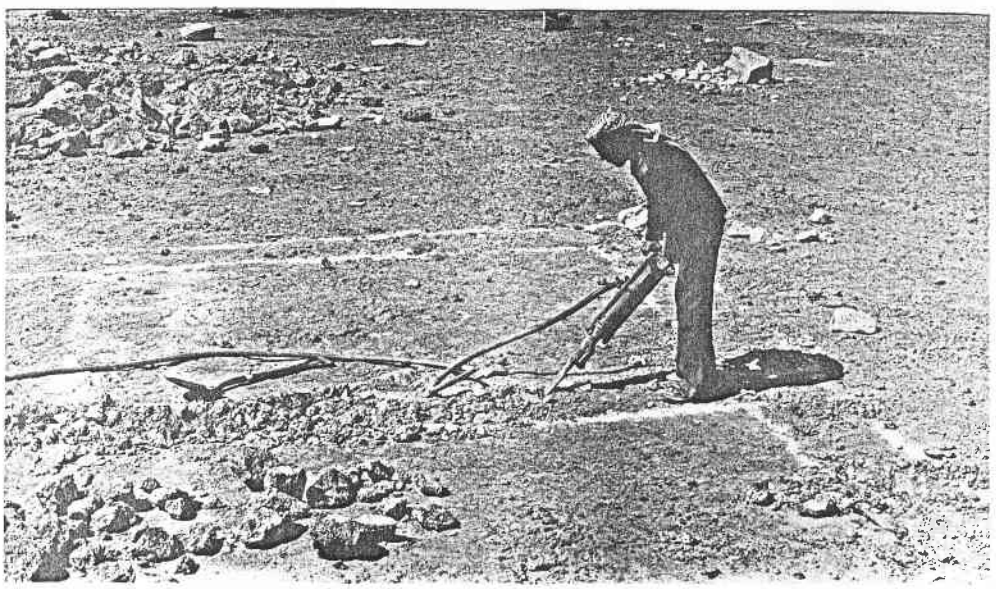
The position of the foundations was indicated by means of steel rods and masonry lines. The excavation was done between those lines.

Since construction was realized nearly directly on the hard rock, very little excavation was necessary.

1.2. Chalking lines.

A better way of tracing the foundation was found by using chalk, which was dropped by hand along the masons line. This way the masons line could be removed and easy excavation work was possible.

The contractor working simultaneously on the same terrain used a pneumatical hammer in order to loosen the surface soil. It is considered that if the soil is so firm that pneumatic gear has to be used in order to loosen it, it does not have to be loosened at all.
On the other hand it is important that running surface water after heavy rains, cannot undermine the foundation. In that case, with superficial foundations, direct contact has to be found with the rock.

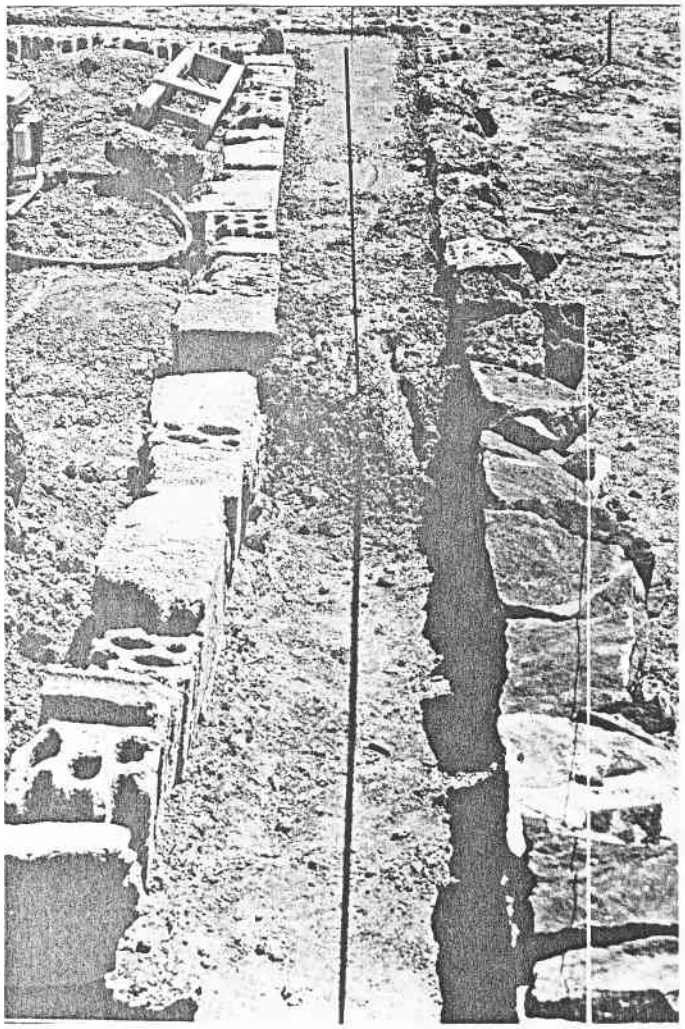


1.3. Use of timber.

For the casting of the foundation strip a timber formwork was used, consisting of two planks and vertical cross timbers. The verticals were kept rather long, so it would be possible to use the timber afterwards for other purposes. On top of an unreinforced concrete layer including stones, a reinforced layer was cast. The same type of timber formwork was used for this second layer, using smooth timber. The amount of timber used proved to be inconvenient because of the high pieces sticking out and expensive.

1.4. Use of stones and cement blocks.

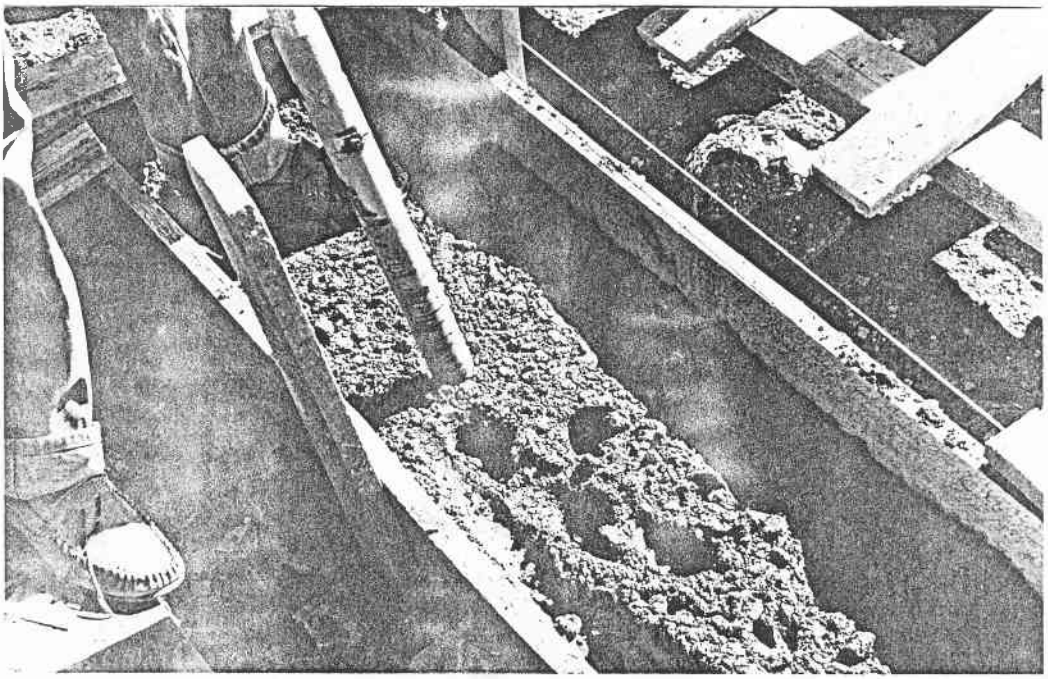
In order to cast the foundation strips at lower cost, two lines of broken cement blocks and stones were used for the other houses to cast the rough concrete layer, and to provide a flat working surface for the foundation tie-beam.
The rough concrete was cast on the uneven ground surface and the vertical reinforcements were placed in this concrete.
The total width of this first leveling course is more than the required wall thickness.
For softer soils the foundation should be made deeper and the footing should be made wider.
After hardening of the concrete the stones were removed and used in the construction of the walls.



1.5. Casting of concrete.

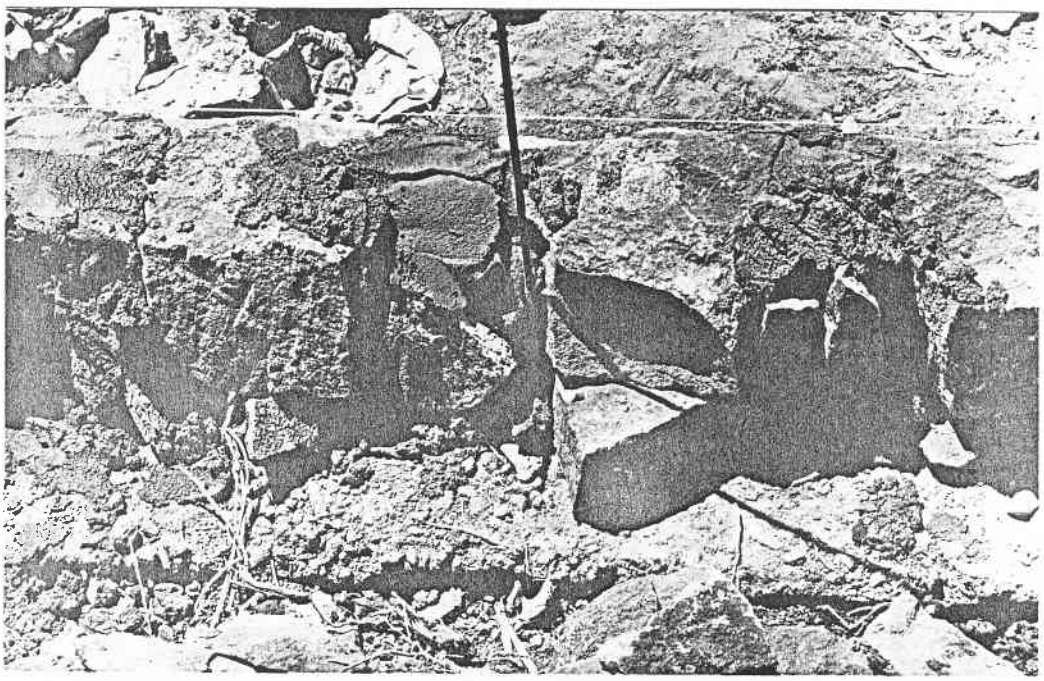
The mixing of the concrete was done with a motor mixer with a content of 200 liter. An effort was made to keep the water-cement factor as low as 0.5, and to obtain a high concrete quality by mechanical vibration. Due to water absorbsion by the volcanic stone and the high evaporation, the concrete mortar was too dry and even with prolonged vibration the concrete mass did not liquidize. The most appropriate water-cement factor in combination with the vibrator was 0.7.

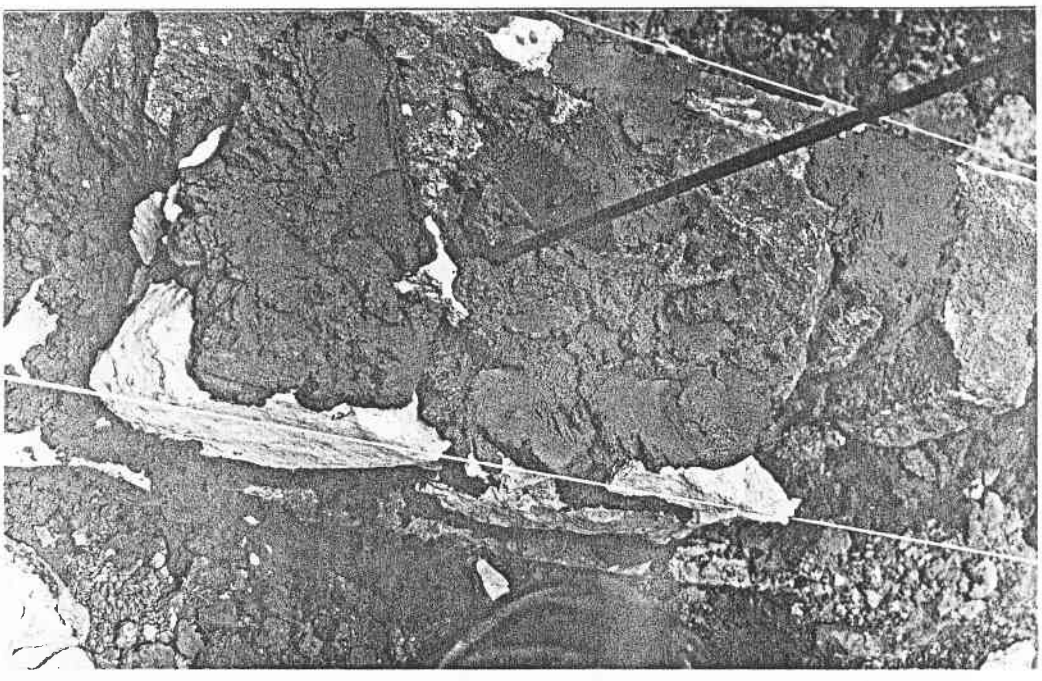
After the casting of the foundation strip, the same was kept wet for several consecutive days.



1.6. Bars in stone masonry foundation.

The first layers of the foundation upto floor level were made in black tuff stone, and the stones were laid around the vertical reinforcement bars.
The stones make often contact with the reinforcement bars and may cause corrosion, particularly because the foundation may retain long time its humidity after rains.
If the reinforcement bars have to go through stone masonry, they should be cast in concrete, which does sufficiently surround the bars on all sides. A proposal has been made to separate the bar from the stone during the masonry with a (temporary) 10-12cm plastic pipe.

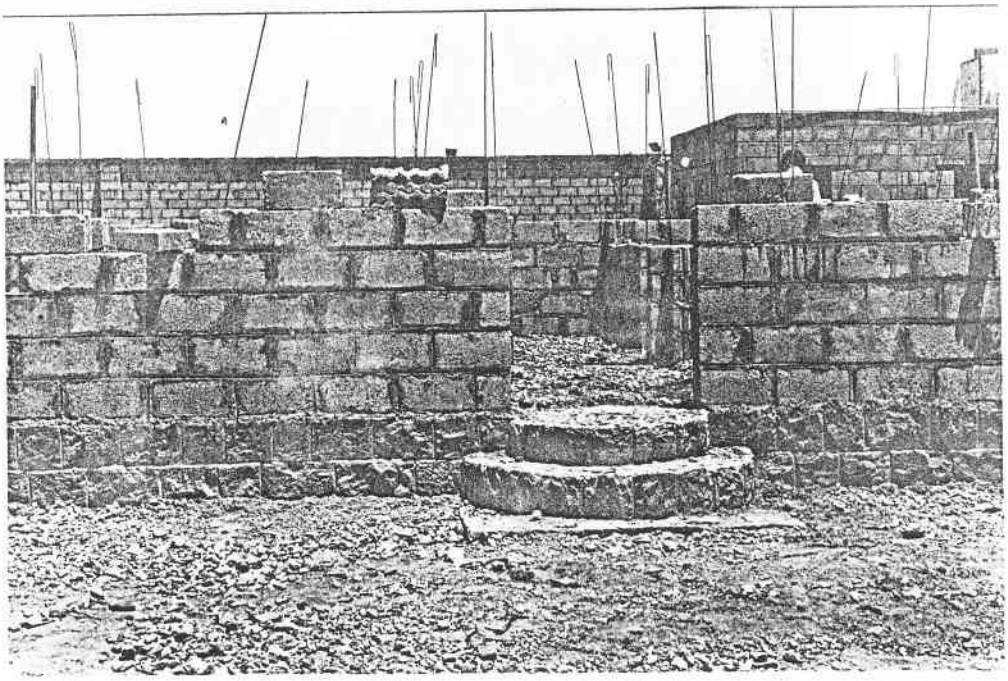




2. CEMENT BLOCK HOUSE (house I)

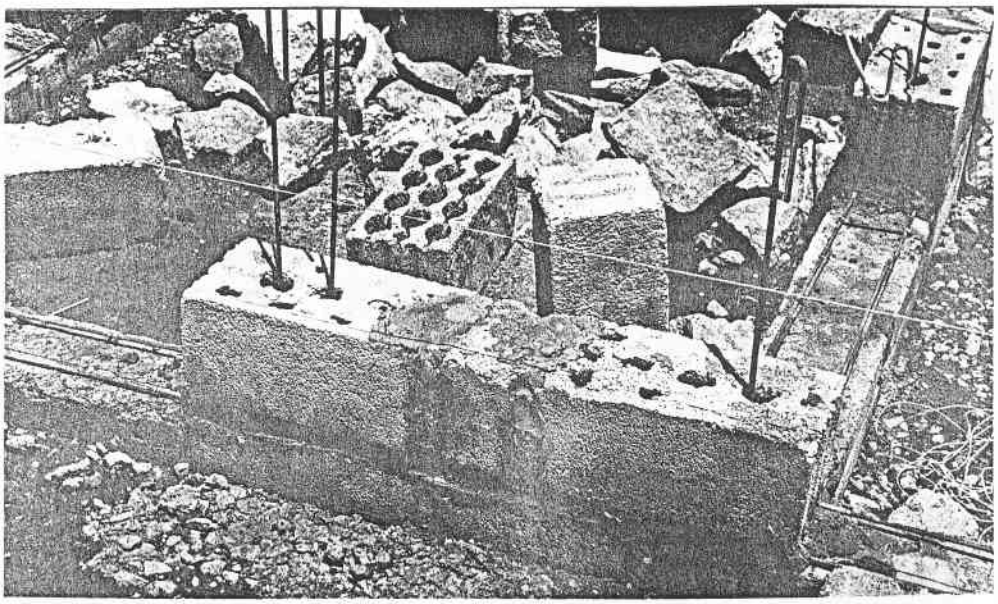
2.1. Distribution of reinforcement and stone foundation.

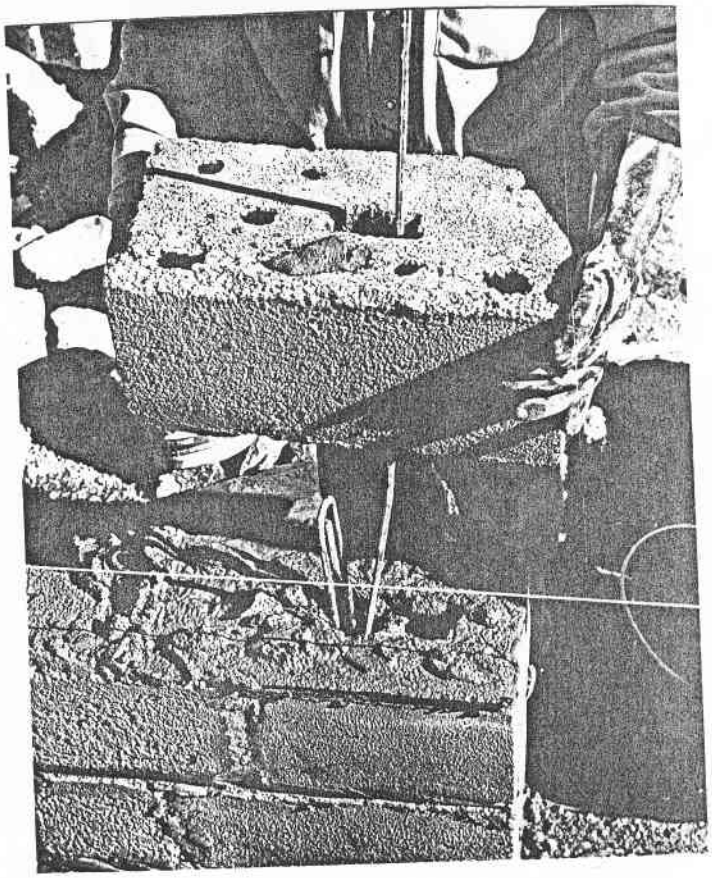
In the cement block house a single vertical reinforcement bar was placed at every opening of door or window. At the corners and intersections of the walls an additional bar was placed.
The position of the bars was planned to correspond with the holes in the hollow cement blocks, but because of the use of natural stone in the foundation this coordination was partly lost. It is not recommended to make a stone foundation for a cement block house, but to use exclusively solid cement blocks in the foundation.



2.2. Eleven holes cement block.

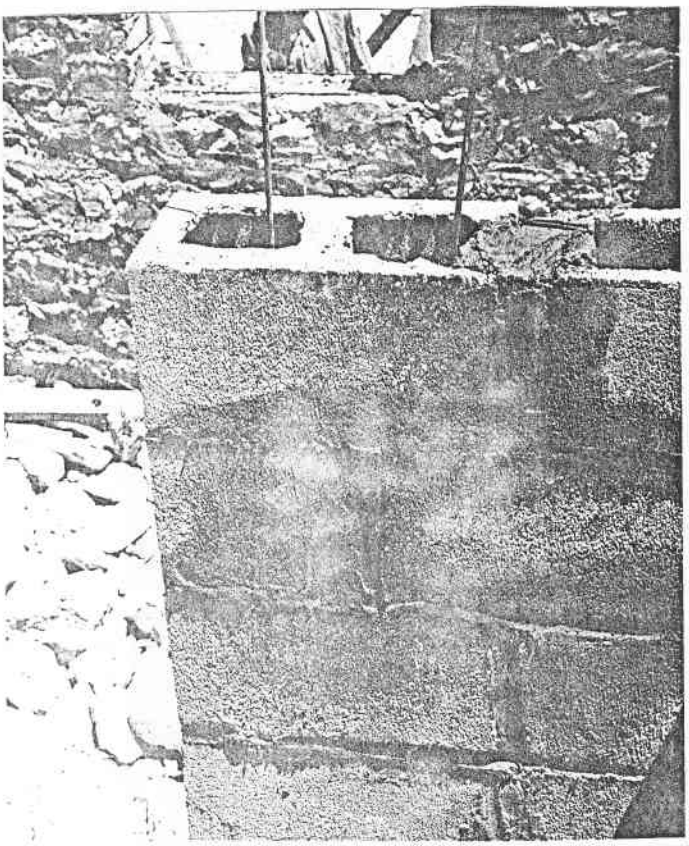
Contrary to the design the 11 holes cement blocks were used as hollow cement blocks in order to pass the reinforcement through.
The results were that it is not possible to keep the correct position of the bars, and the filling of the holes with concrete could not be properly done.
In some cases the holes were not filled at all and in other cases the holes were filled with masons mortar. In both cases the covering of the reinforcement bars with strong cement mortar of sufficient thickness was not achieved.

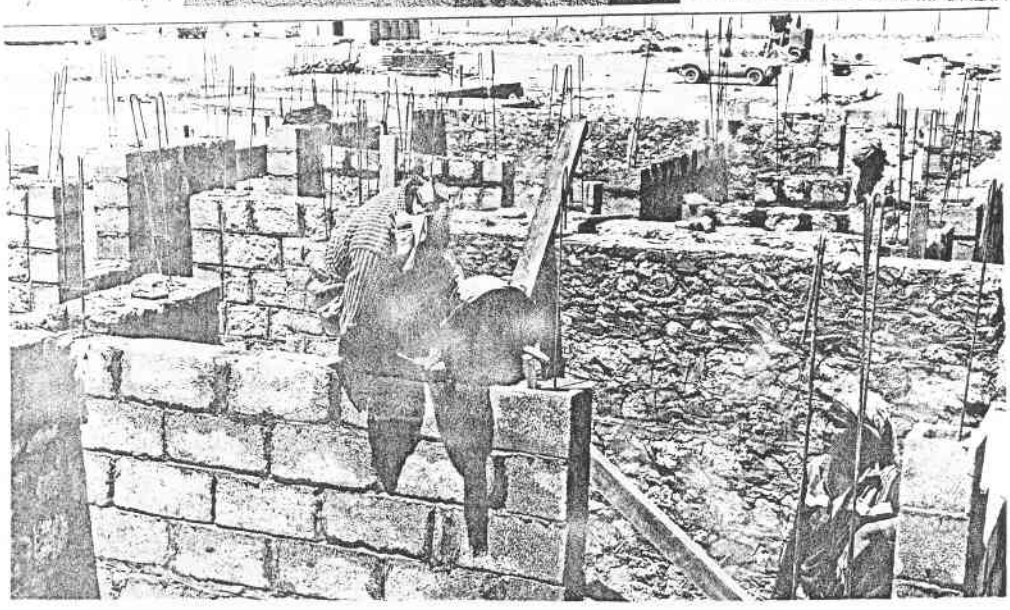




2.3. Two holes cement block.

At those places where a vertical reinforcement bar was planned, a B shaped hollow cement block was placed, which was filled after each course with concrete with fine concrete. The maximum aggregate seize had to be 1/2" or 1-1,5cm.
The concrete was rather liquid because the very dry and porous cement blocks absorb a lot of water. It was necessary to water the cement blocks sufficiently before the concrete was cast.
The B shaped cement blocks formed this way a strong framing of the openings.



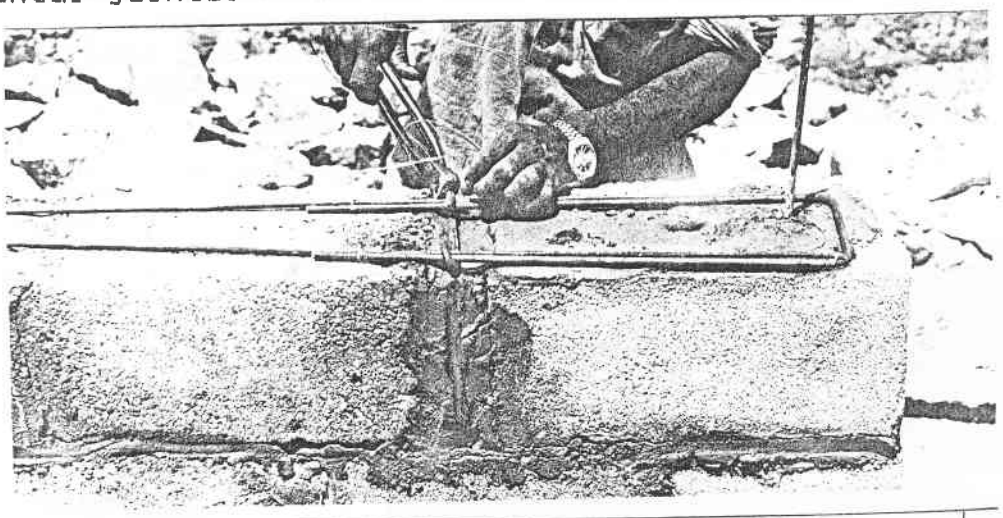


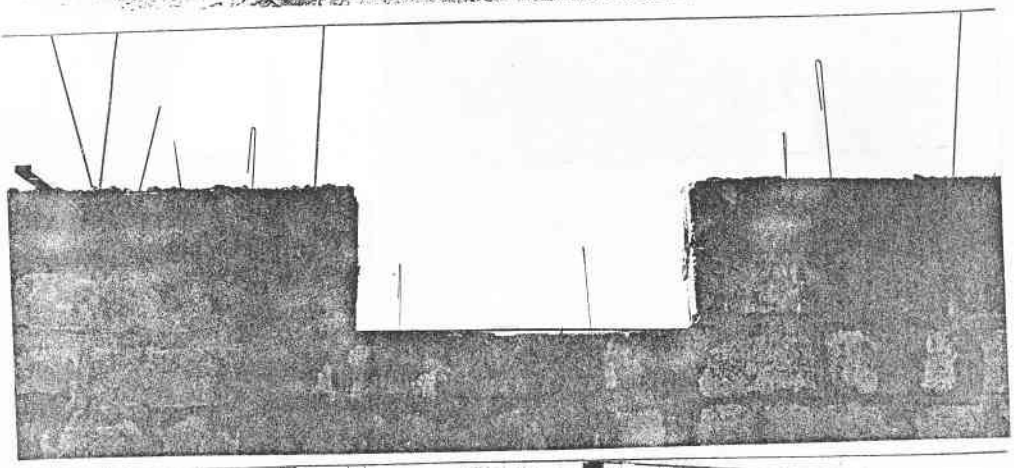
2.4. Lengthening of reinforcement bars.

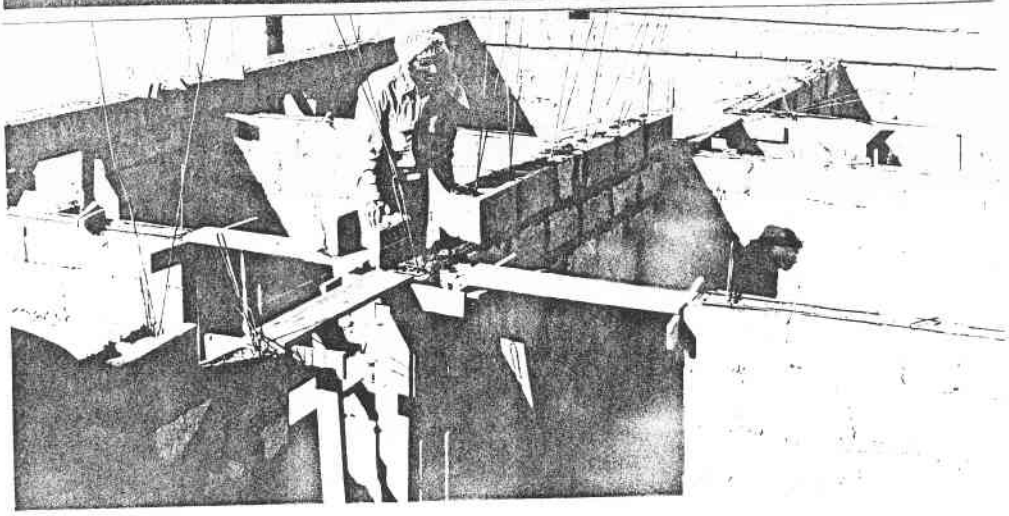
The vertical reinforcement bars have a diameter of 8mm or 10mm at the most. The 6mm vertical bar will too easily bend. When working at a higher level, it became difficult to put the hollow cement blocks over the top of the bars, especially when this were the 11 holes blocks.
This problem is a small disadvantage of the system with the hollow cement blocks.
Another disadvantage of the long protruding lengths of vertical iron, was their swinging movements in the wind. These movements caused that the bottom of the bar, where cast-in, became separated from the concrete.
The solution to avoid these both problems was, to shorten the lenthening bars, and to have 4 lengths instead of 3 lengths in the height of the building.

2.5. Horizontal reinforcement.

Under all the windows, and over all the doors and windows, horizontal reinforcement is placed in the wall.
The lower reinforcement consist out of 2 times 6mm, but according to the steel supply, 2 of 8mm was put in. This gave an extra thick horizontal joint.
Over the windows in the outside walls, the horizontal reinforcement is placed in the U block beams. Over the doors in the inside walls also U blocks were placed. In the remaining wall the horizontal reinforcement was placed in the horizontal joints.

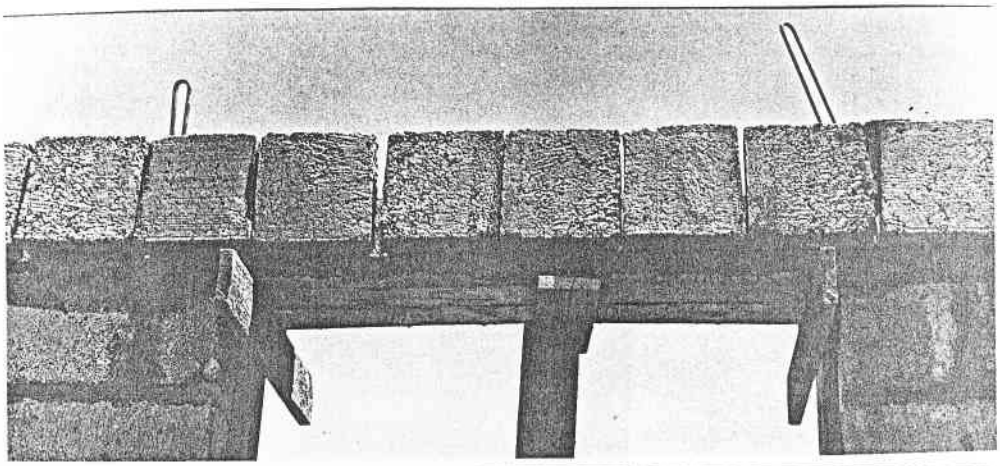


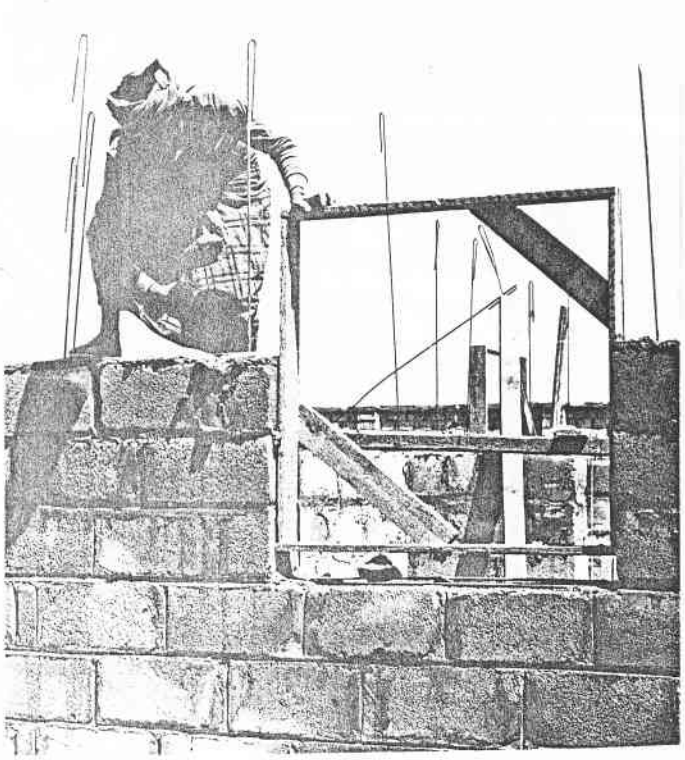




2.6. Making of window openings.

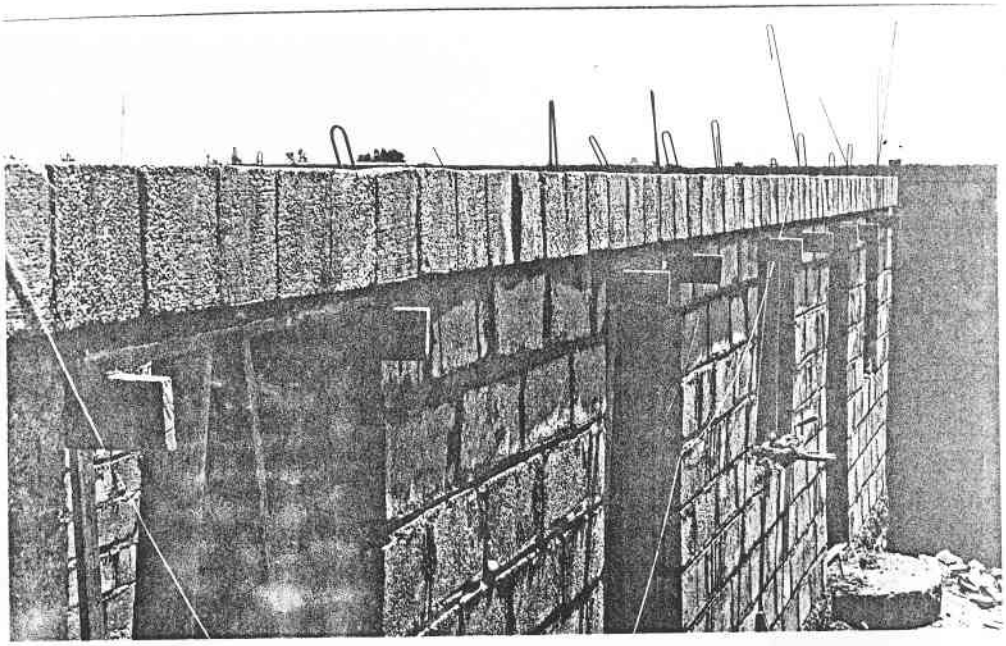
The openings were made with the aid of a temporary frame, which would at the same time support the U blocks for the lintel tie-beam. The frame, however was not strong enough and was bend under the horizontal load of the cement blocks which were pressed against it.
The windows and doors were ordered when all the openings were finished, and made to the seize of the openings.
The U block beam was laid in a layer of very sandy mortar, and the temporary window frame had to be supported in the middle to avoid bending. On the upper side of the frame an extra plank had to be added in order to give sufficient support for the U blocks.

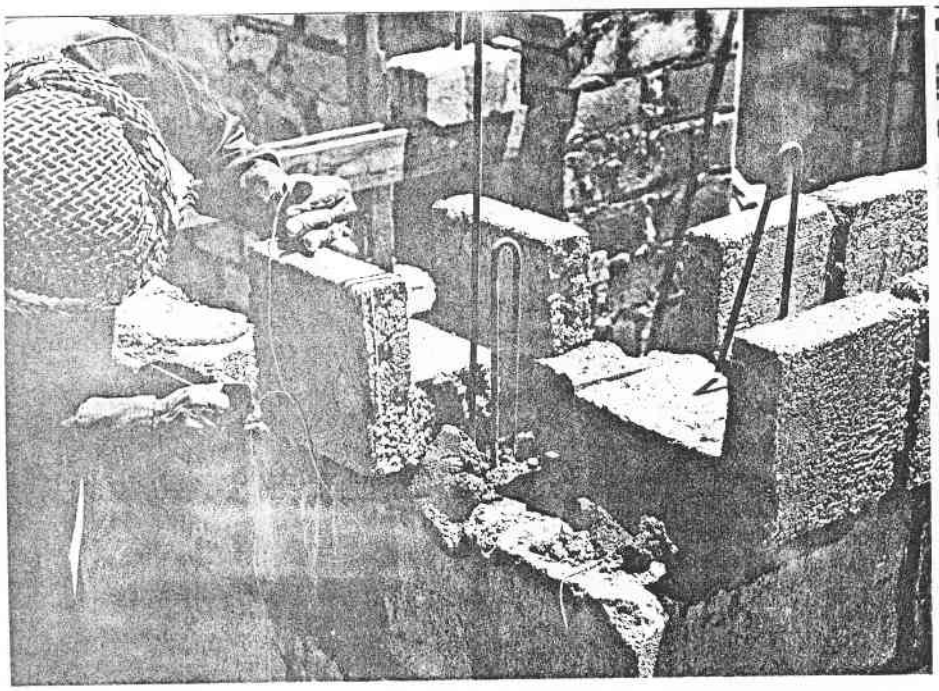


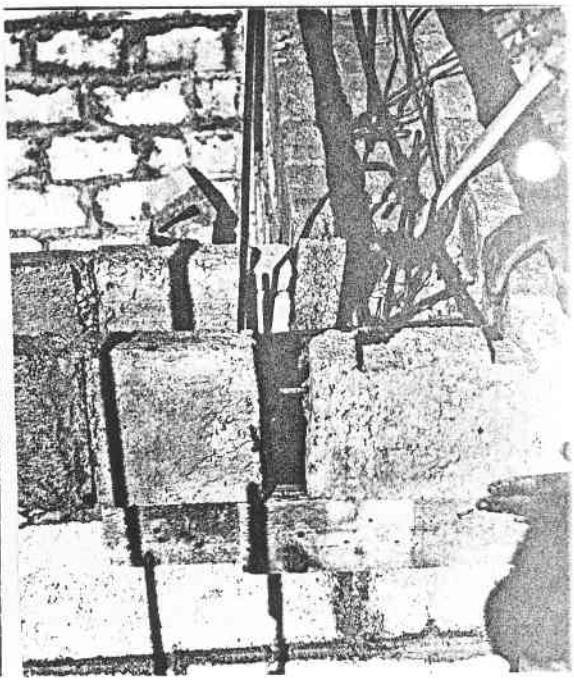


2.7. The U block lintel beam.

Over the outside perimeter of the cement block house an U block lintel beam has been made, but not over the inside walls, except over the inner doors.
In order to allow the vertical reinforcement bars to come through the U blocks at the right places, the horizontal bridge was partly cut away with a hammer.
The corner solution was made by placing a U block with one wing only at its side.
The little joints between the blocks were washed in with mortar in order to avoid leakage of concrete.

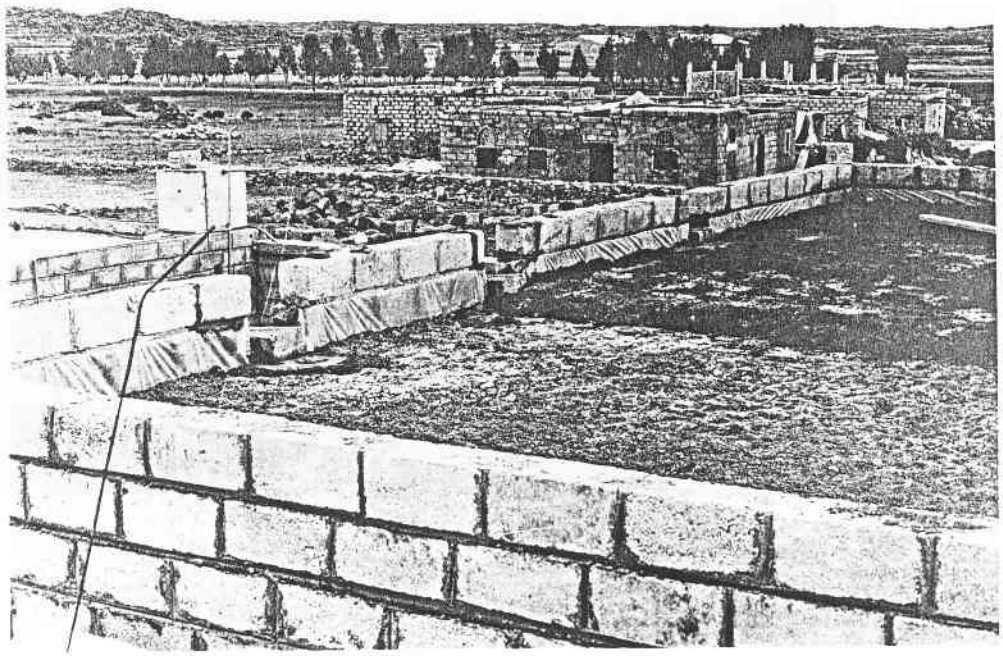


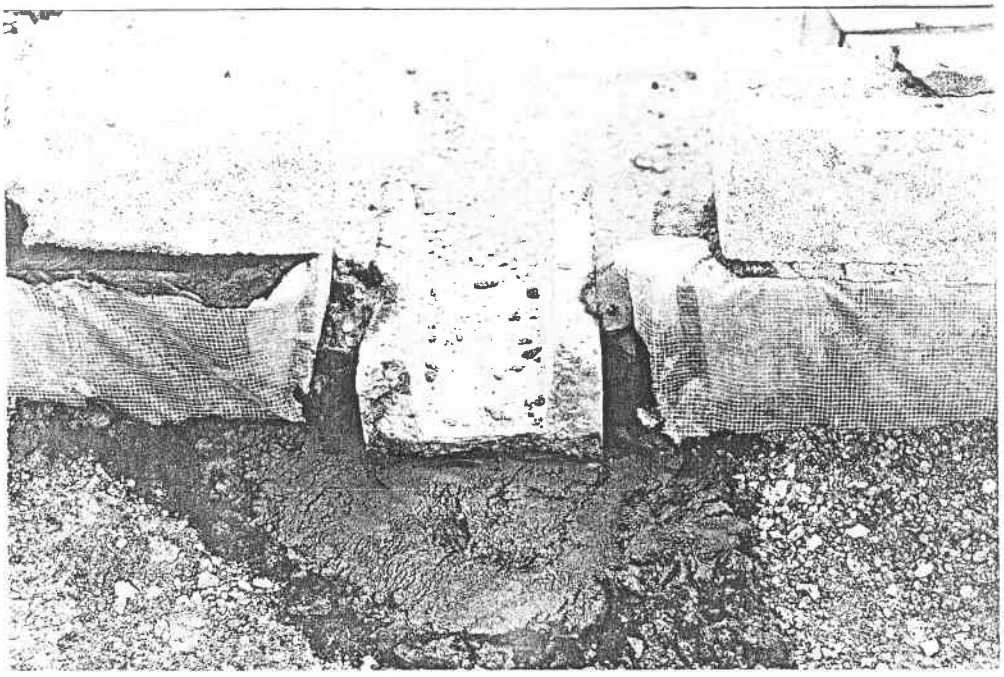




2.9. Roof plastic.

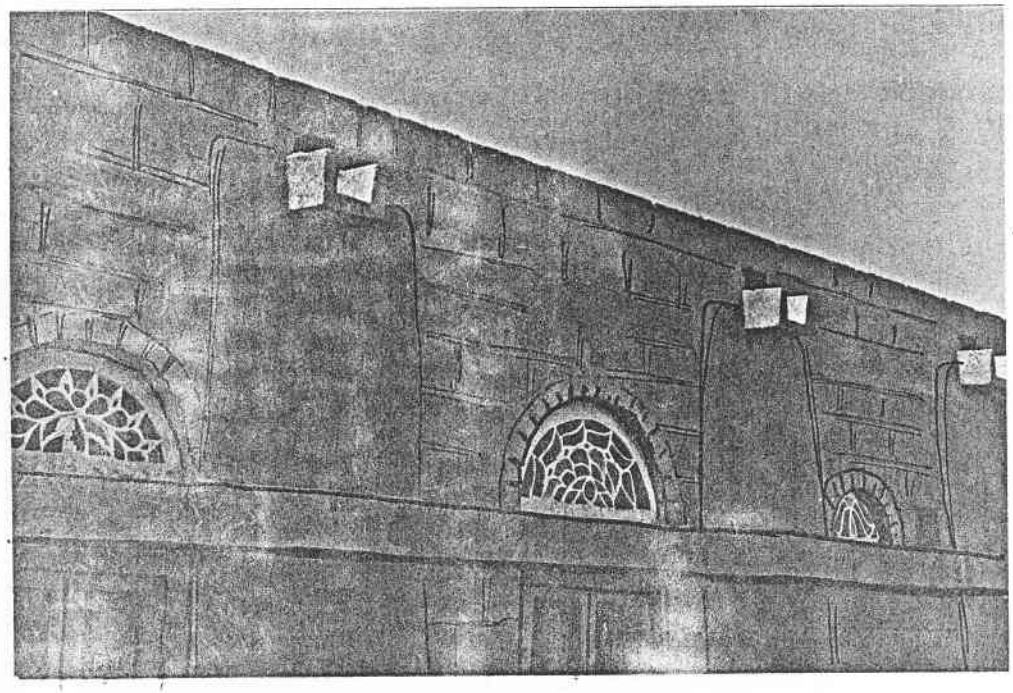
The impermeable roofsheet was placed with the sides up against the walls. The gutter piece was placed on top of this sheet where the wall was interrupted. This gave a barrier to the draining water. In the other houses the gutterpiece was placed lower, and the plastic made flush with the gutter.
The roof was filled with a stabilized mud layer (mixture 1 cement and 20 mudsoil), but the mixture of cement and the mud was made difficult by adding water. For the modelhouses in the project area a dry mixture of lime and mudsoil is recommended. The lime will harden itself with the moisture from the soil.





2.10. Plastering of the cement block house.

The cement block house was plastered inside and outside. The front of the outside was plastered with a smooth finish, whilst the backside of the house was brushed with a cement-sand mixture, thus leaving the general texture of the cement blocks in view. This last mentioned method is much cheaper in labour and material than the first, but gives adequate sealing of the porous cement block wall.

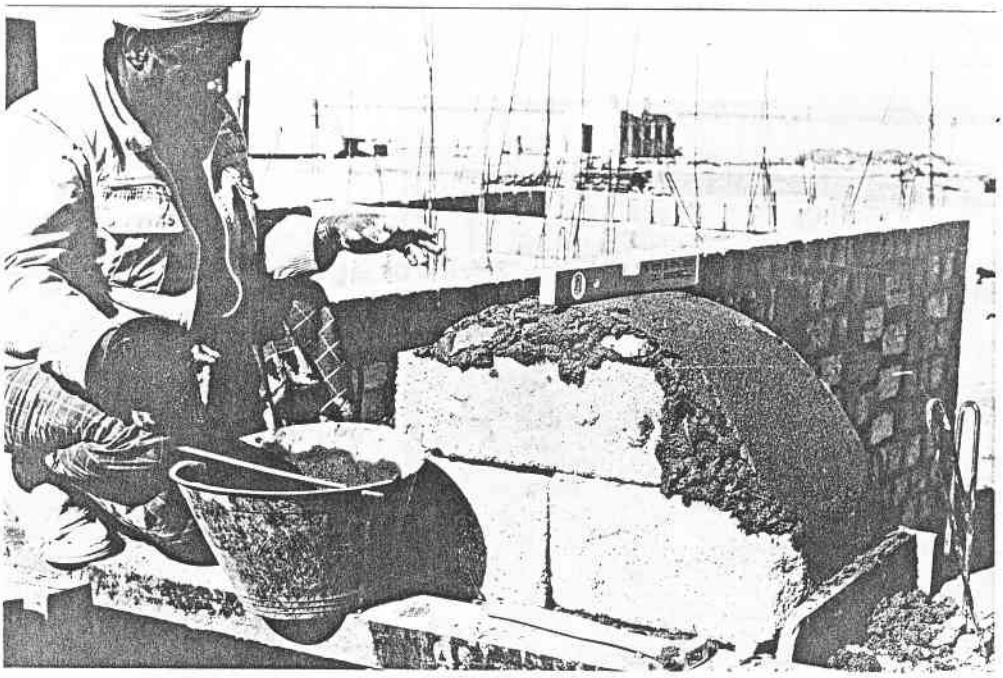


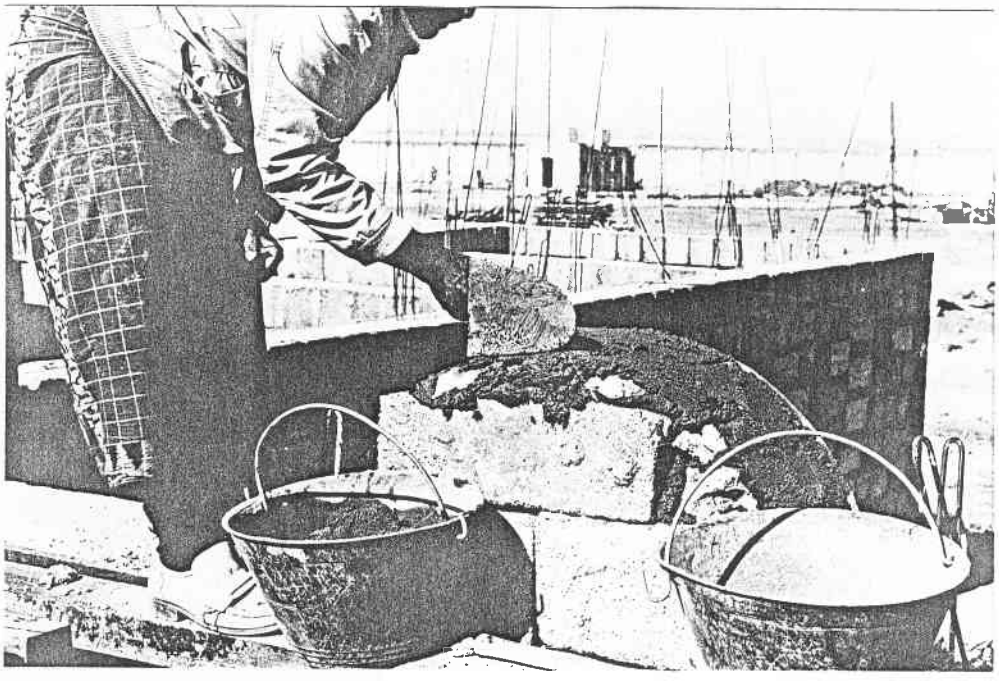
PLASTERED AGAINST
LEAKING WATER OF GUTTER

COATED
WITH CEMENTED BRUSH

2.8. Yemeny arched windows.

On top of the lintel tie-beam a series of traditional arched windows were masoned. In order to have a correct shape, a plywood half round form was made, against which an infill for the arch was made, using 3 cement blocks and a very sandy mortar. Care was taken that the formwork was made level. The production of forms was about 5-6 per day for a mason. Since this is too expensive (YR 50 per form), it is decided to make a metal form which can be reused many times. The seize of the doors and windows must therefore be standarized at a width of 90 cm.

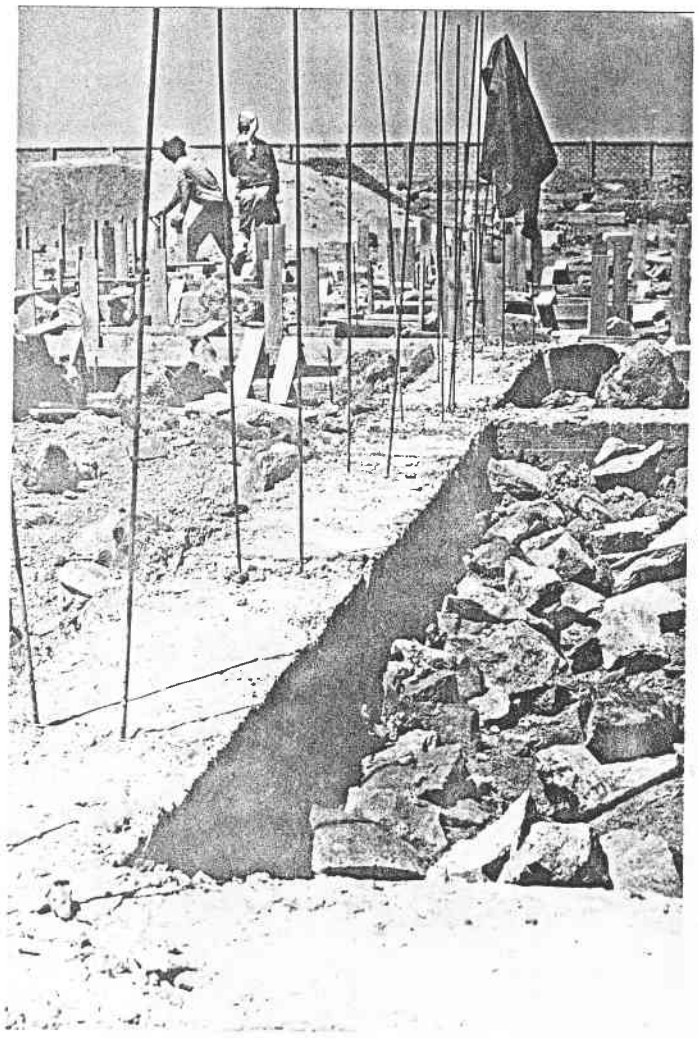


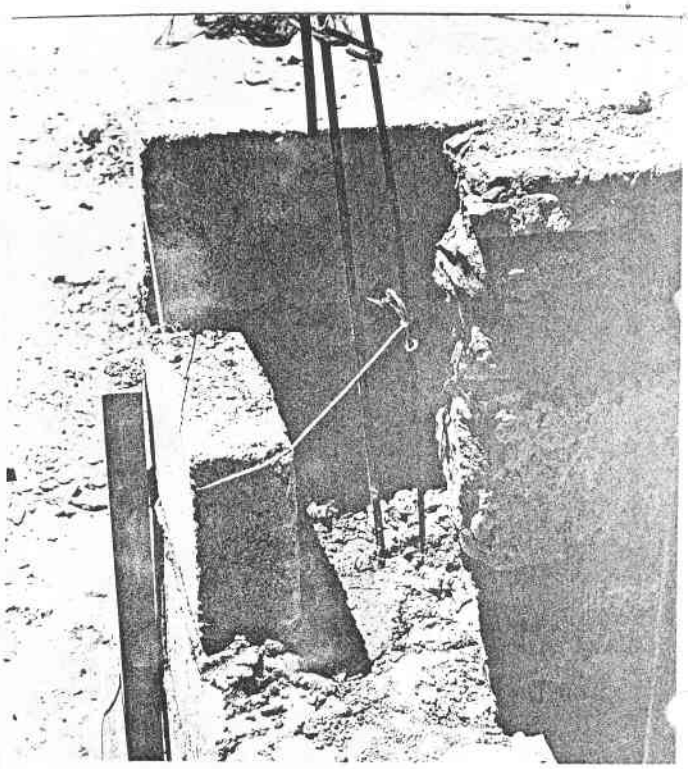


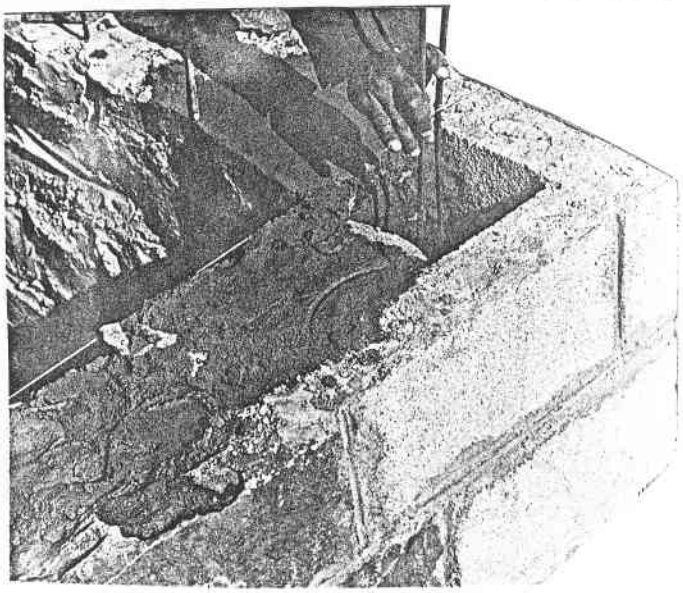
3. STONE HOUSE WITH CEMENT BLOCK CORNERS (house II)

3.1. Double reinforcement.

The double reinforcements are placed at the positions of the openings of doors and windows, as well as the intersections of the walls and the corners of the building.
The corners of the building are build up with solid 10cm thick cement blocks, with the stone masonry they form a hollow in which the reinforcement bars rise. Around these bars concrete can be cast easily.
After every completed horizontal layer all the hollows have to be filled with concrete, consisting of small seized aggregate. If many courses at once are filled with concrete and compacted with a rod or stick, the resulting horizontal pressure may push the cement blocks away from the stone wall.

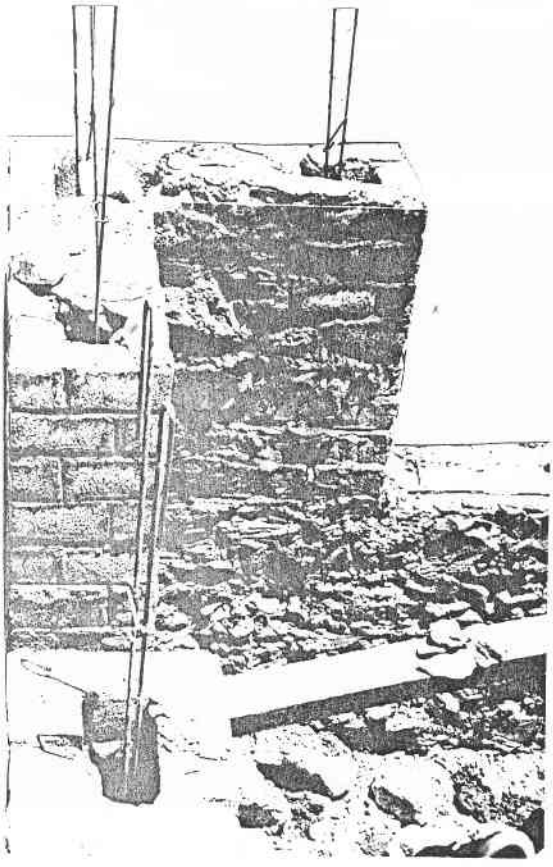


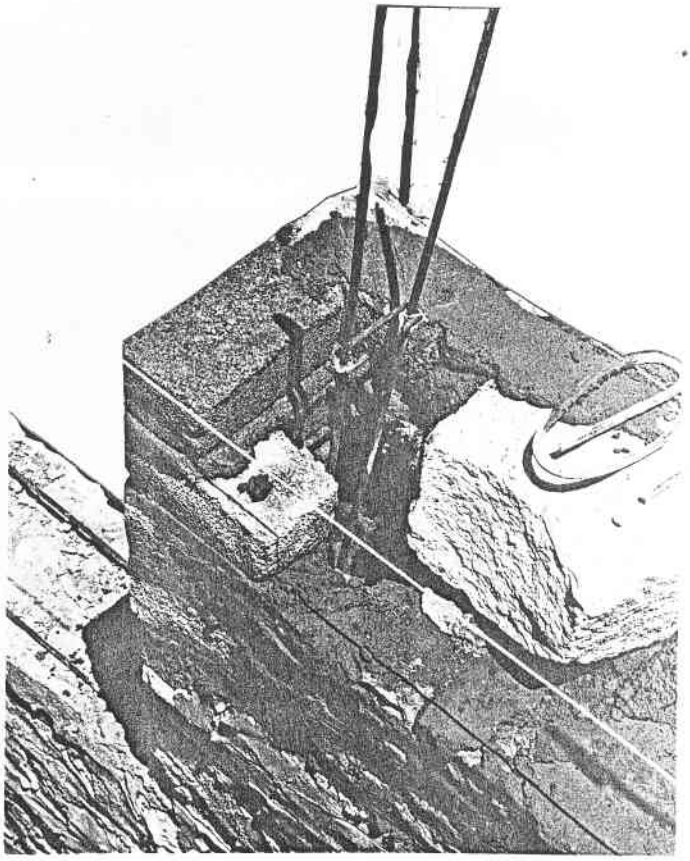




3.2. Door and window openings.

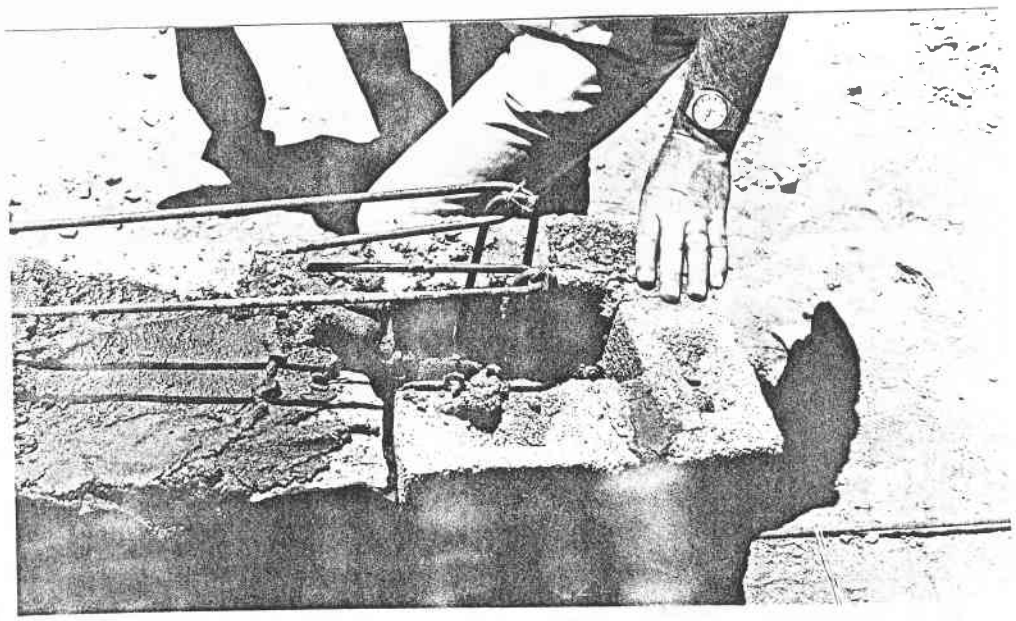
On the sides of the doors and windows smaller seize cement bricks were used 7x10x20cm, to form a straight vertical border for the stone masonry, as well as a vertical channel for the vertical reinforcement.
Horizontal ties held the bars apart, but the double bars at the door and window openings were further considered as excessive and cumbersome to work with.
The openings were not masoned with a frame in the opening.

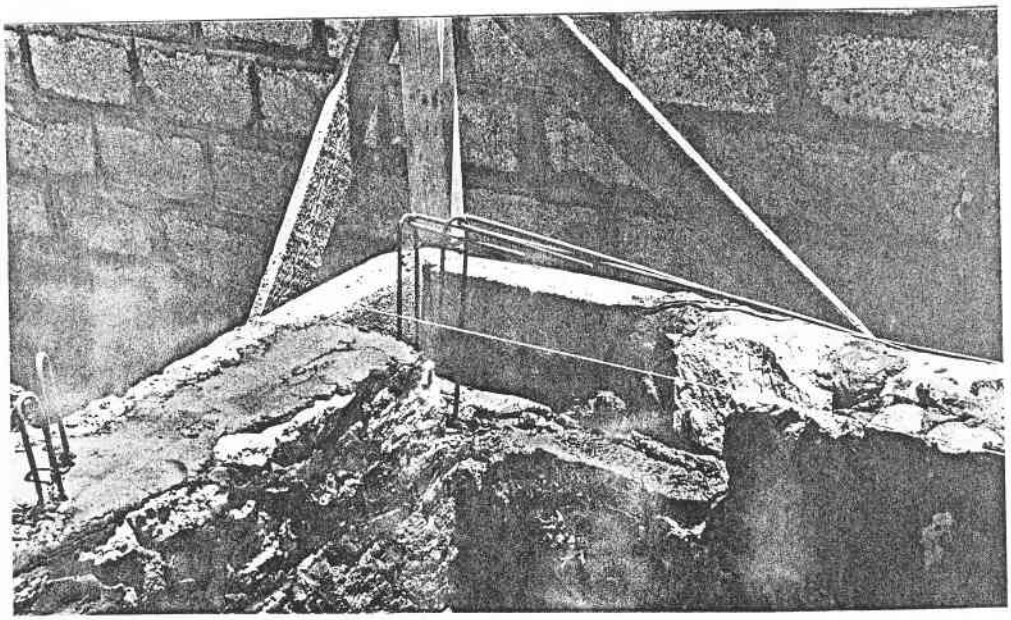




3.3. Overlaps or hooks in the bars.

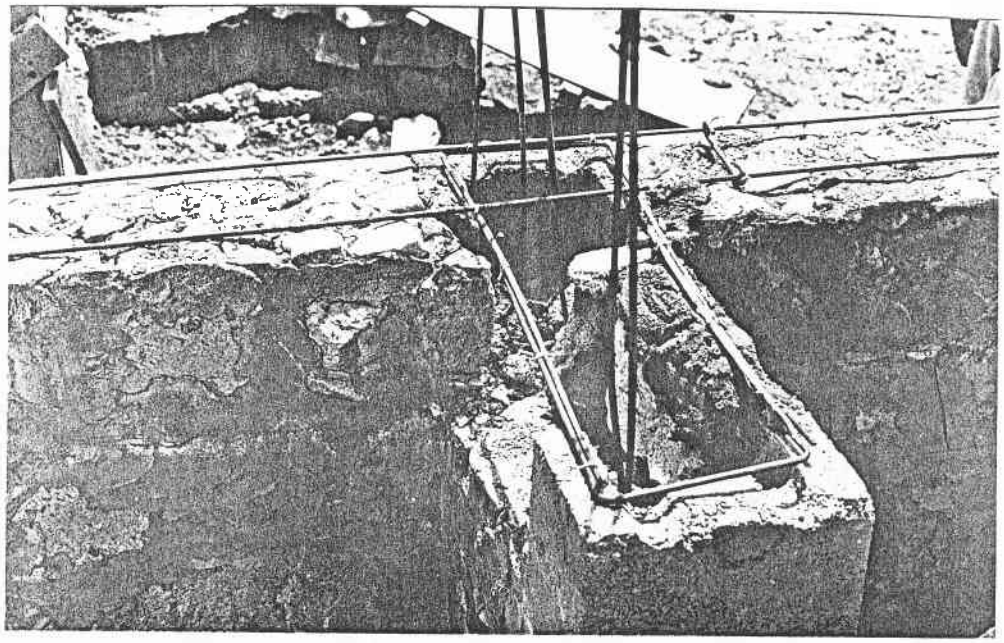
For lengthening the bars, a choice was made between an overlap of 30 times the bar diameter or a hook on both bars. The overlap should have been made by pushing the lengthening bar into the fresh concrete, next to the other bar. Because the real overlapping length will with this method not be good controllable, the preference was given to the double hook.
The minimum considered length of each hook is to be 20cm, and sufficient concrete should be poured all around the bars.
Some strength test have been executed on samples and the hooklength of 20cm showed to be sufficient, only when the concrete had a cross section of minimum 10 cm.

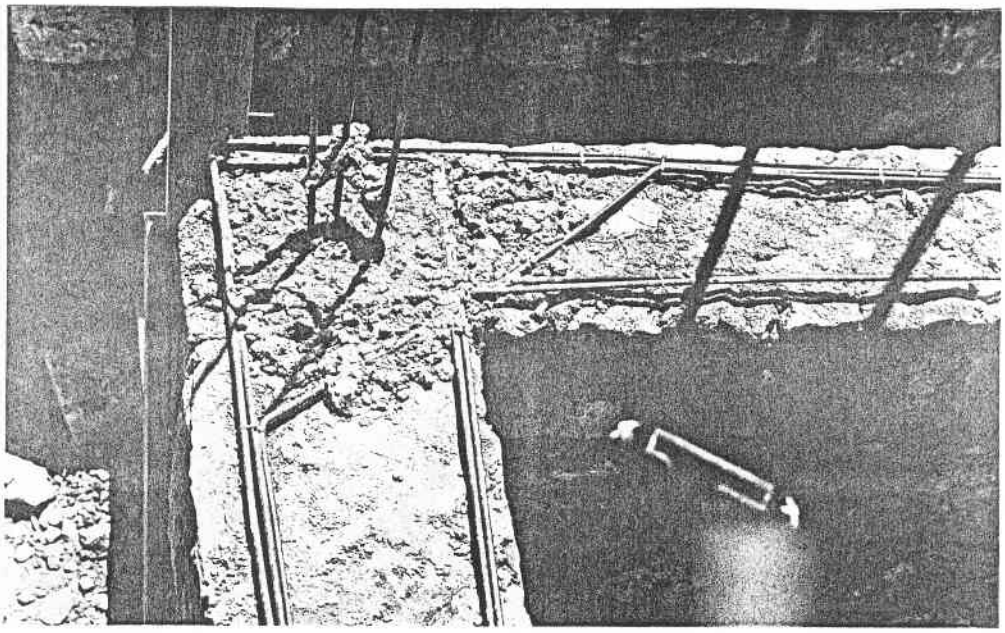




3.4. Horizontal reinforcements

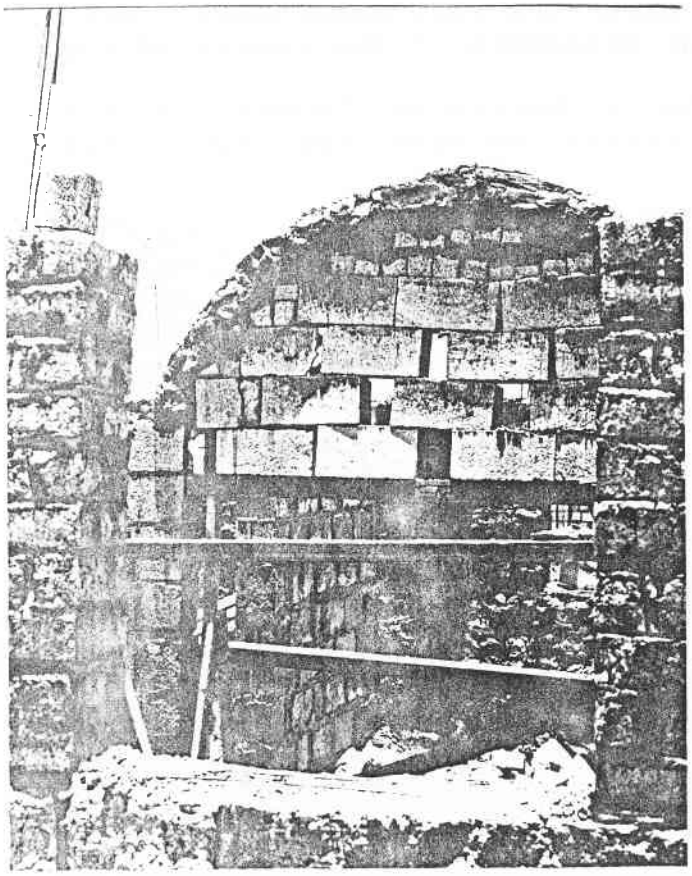
Below window level horizontal reinforcement was placed in both the stone wall houses, however because of lack of 6mm steel bars the much more ridged 8mm bars were used.
Although horizontal ties were specified every 40cm, they were nearly not placed at all.
Over the corner an extra diagonal bar was placed. This diagonal bar was repeated in all lintel beams.
In all corners the hairpin bars are kept continuous, with the overlap of minimum 30 bar diameters in the length of the wall.
The stone masonry was executed in horizontal layers, so the horizontal reinforcements fitted between two horizontal courses.

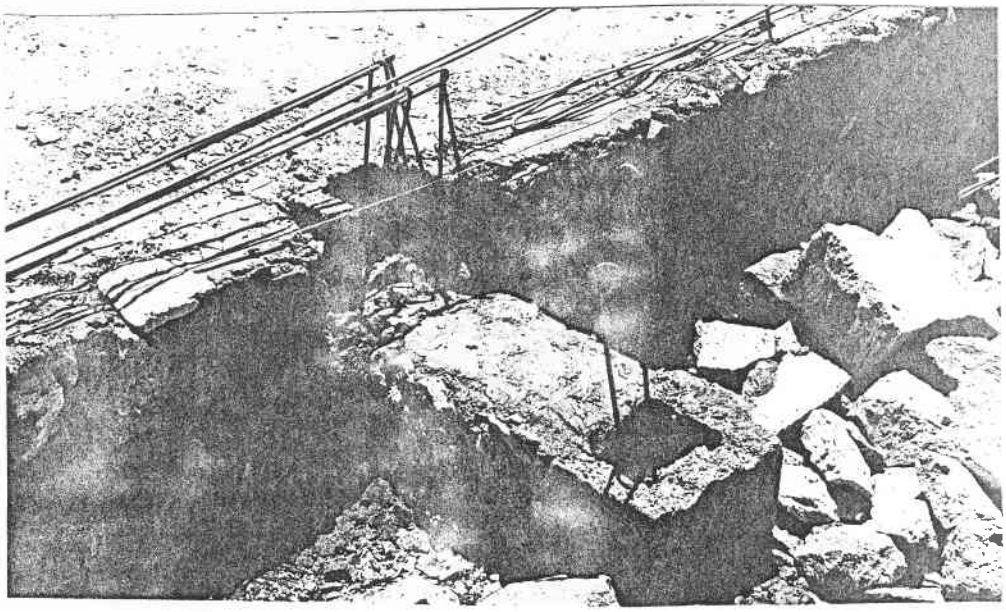




3.5. Making the arch.

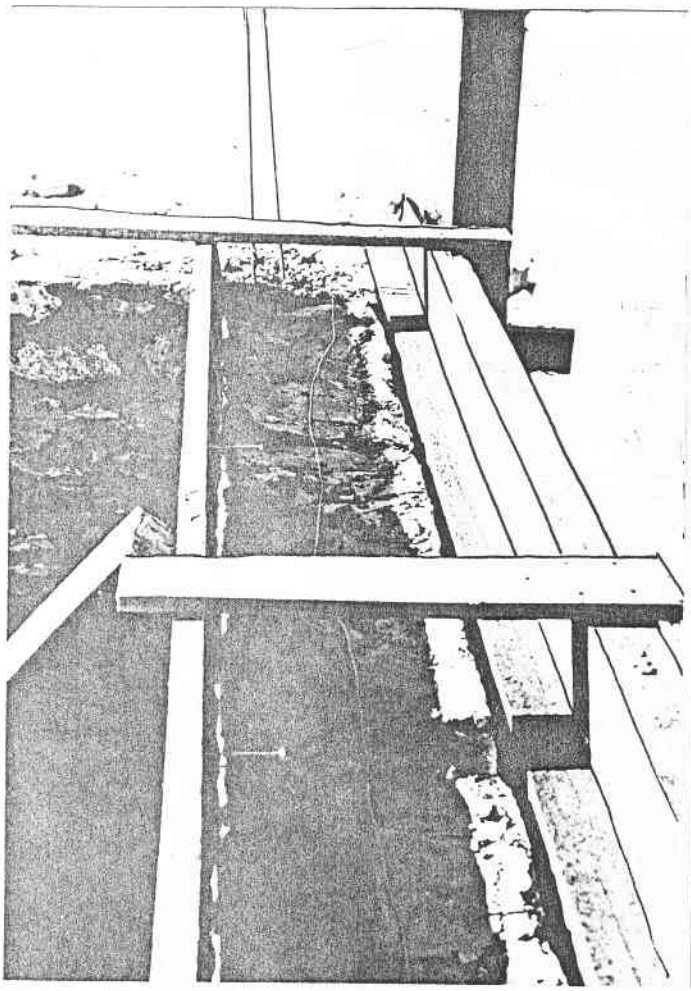
A temporary mould was made to mason the large arch inside the house, connecting two rooms together. The timber formwork support had a height of 1.50 m and the total height of the arch was about 2.50 m.
The bottom picture shows the basis of the pier against the outside wall.





3.6. The formwork for the tie-beams.

In the middle house a tie-beam was made by means of a wooden formwork, consisting out of the straight floor timbers. Many spaces remained between the timbers and the sides of the wall.
On the inside of the tie-beam a plank was cast in and held in position with large nails.
The disadvantages of the making, and afterwards repairing the wider tie-beam with the timber formwork does not make it an advisable construction. The wider tie-beam is more ridged than the smaller U block beam, but much more costly in labour and materials.

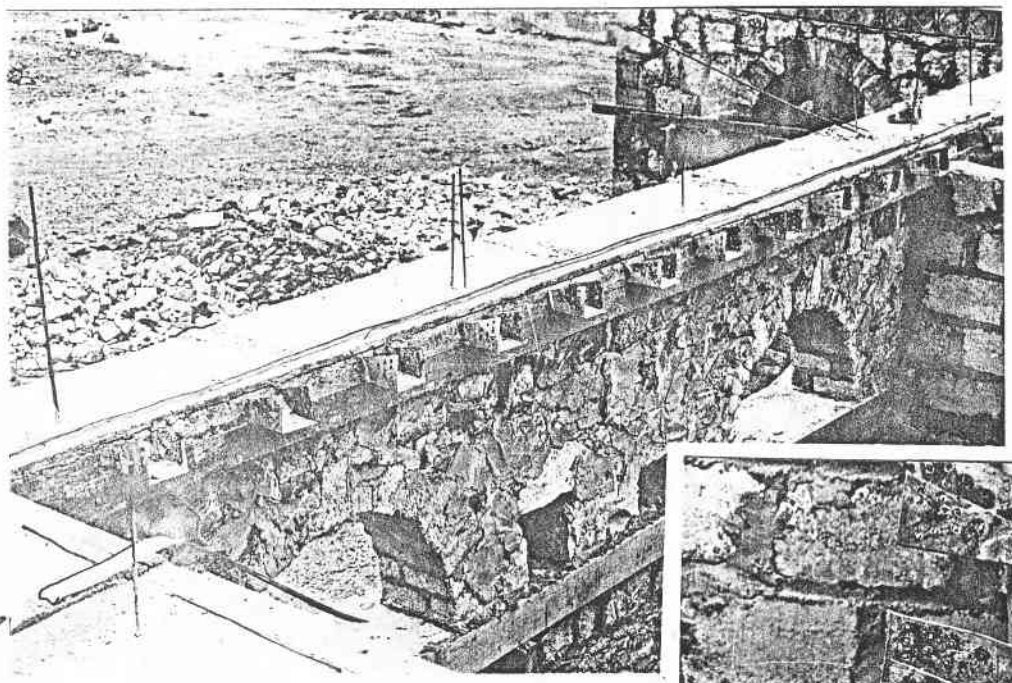


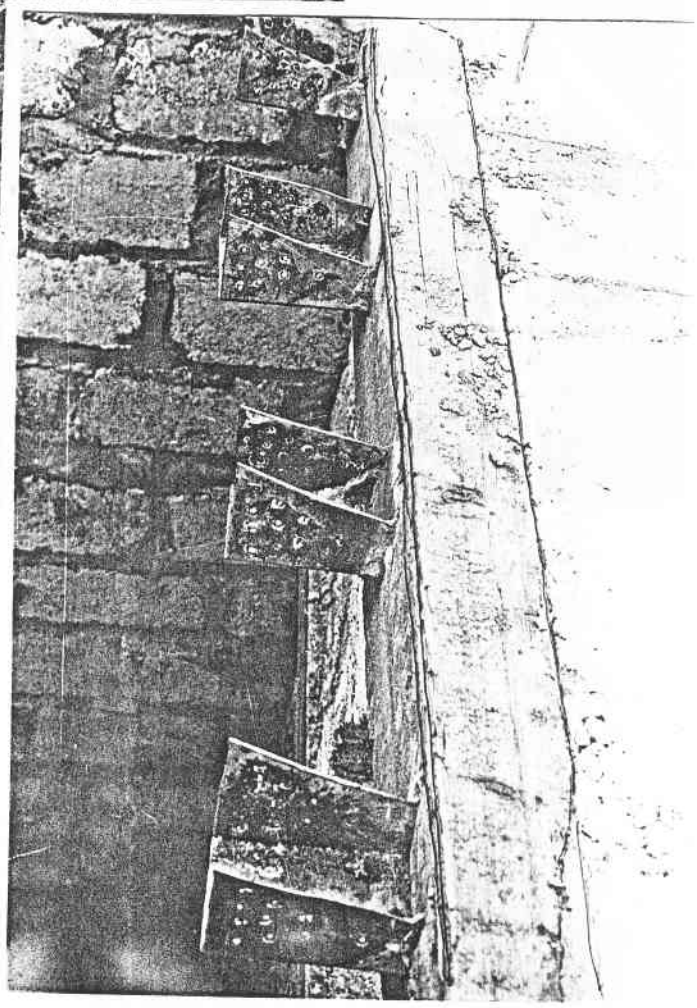
WIDE BEAM
TIMBER FORM
HOUSE II

U BLOCK BEAM
HOUSE I AND III

3.7. Shoes for the floor joists.

In order to make a good connection for the floor joist to the highest tie-beam, special shoes were designed, consisting of folded galvanized metal sheet matal with 10 nail holes on either side. However the nailholes were burned into the sheets and thus very rough. For the nails, concrete or hard steel nails were used in order to enter the hardwood joists.
On top of the shoes, a plank was cast into the tie-beam, for the fixation of the plywood onto the tie-beam. The plank was anchored with a large number of nails into the concrete beam. The whole construction proved to be very good but expensive and complicated.

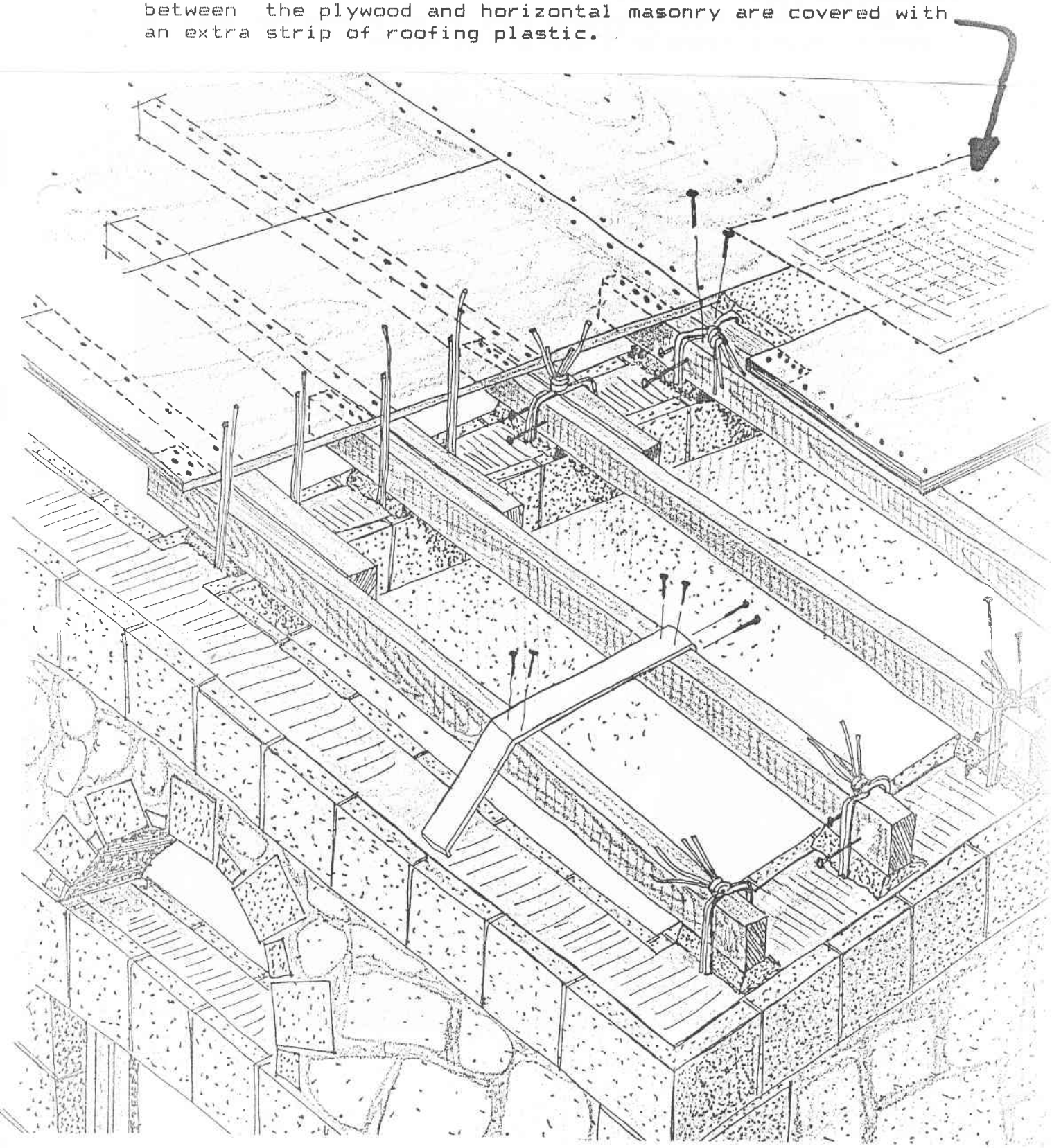




SIDE STRAP
ANCHORING FOR JOISTS
SEE ALSO PARAGRAPH 4.7.

3.8. Plywood floor diaphragm.

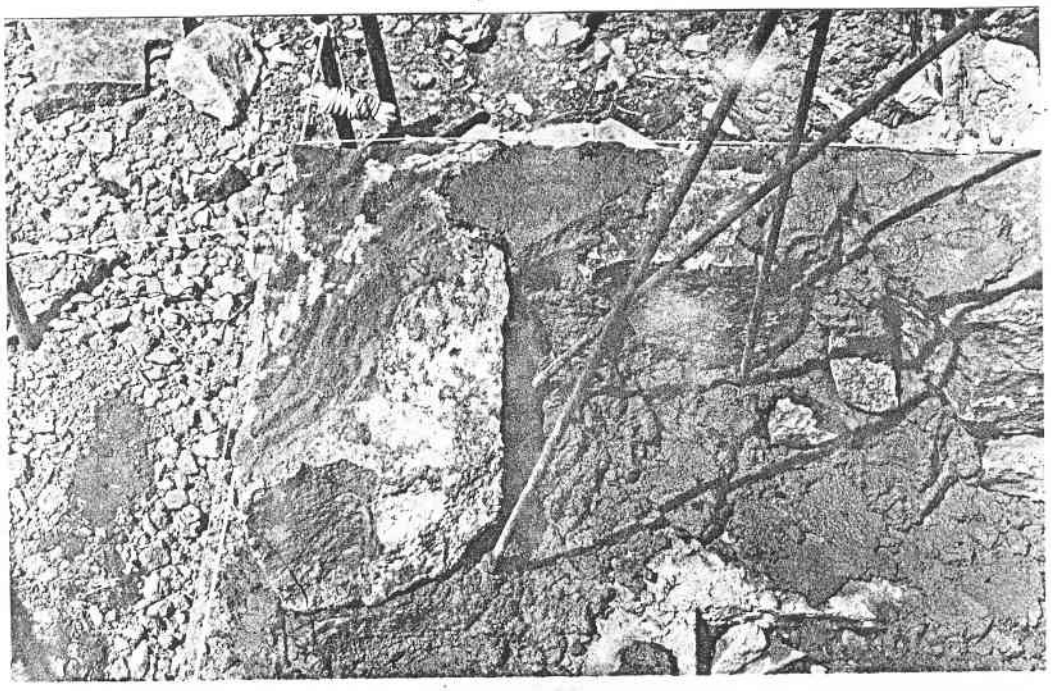
The 12mm thick plywood floor sheets are nailed with steel concrete nails to all the floor joists along all the sides of the sheet at intervals of 20 cm.
Thus the plywood creates a through going diaphragm, integrated with the floor joists and the floor joists are tied to the walls.
The plywood is stopped at the walls in order to allow future erection of the walls for the second story. The joints between the plywood and horizontal masonry are covered with an extra strip of roofing plastic.

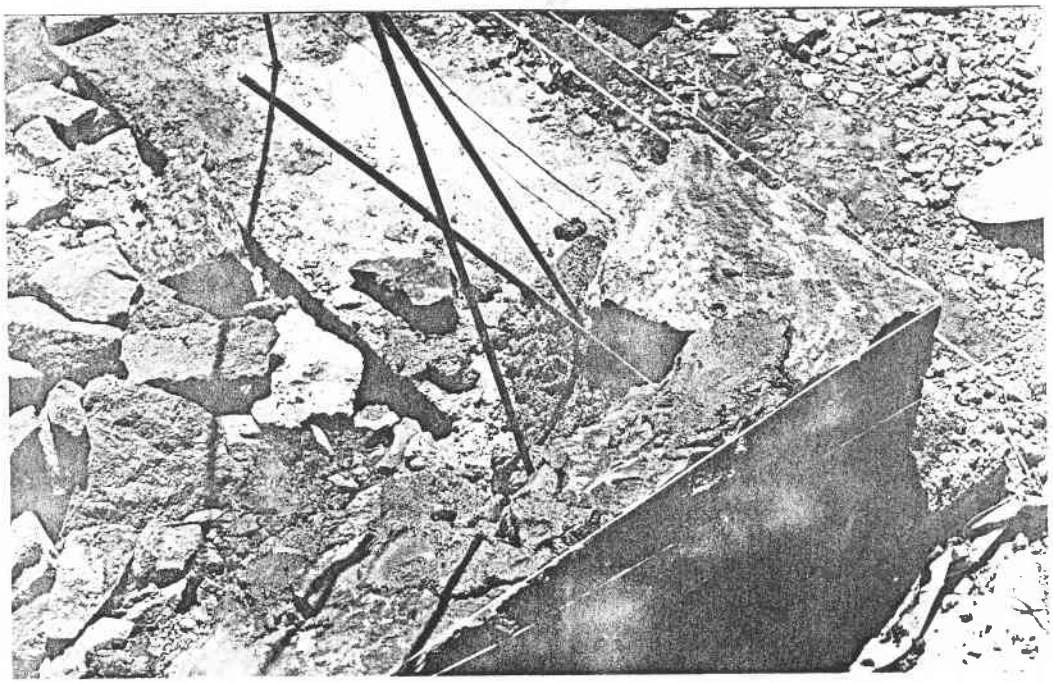


4. THE U BLOCK AND STONE HOUSE. (house III)

4.1. Vertical bars in foundation

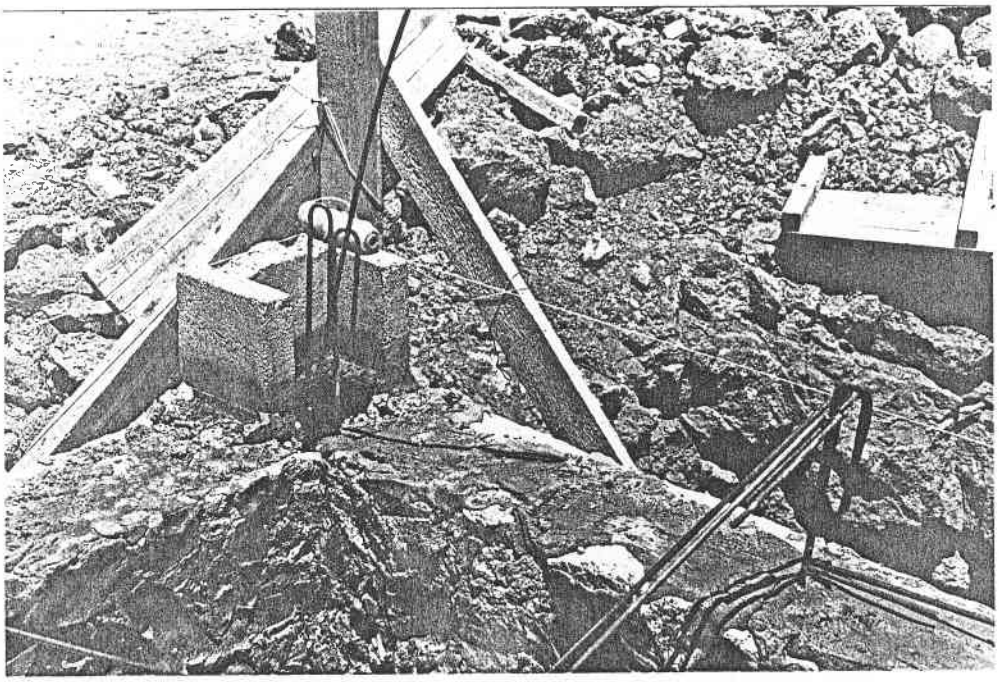
The design of the house had three reinforcement bars in the corners of the walls. Because no U blocks were used in the foundation, the bars came both into direct contact with stones and were bent sideways to give place to the stones. Also the reinforcement bars were only surrounded with the normal masonry mortar.
The U shaped cement corner blocks should be used from the foundation up.
The use of three reinforcement bars is excessive for only a house without a story or a one storey house.

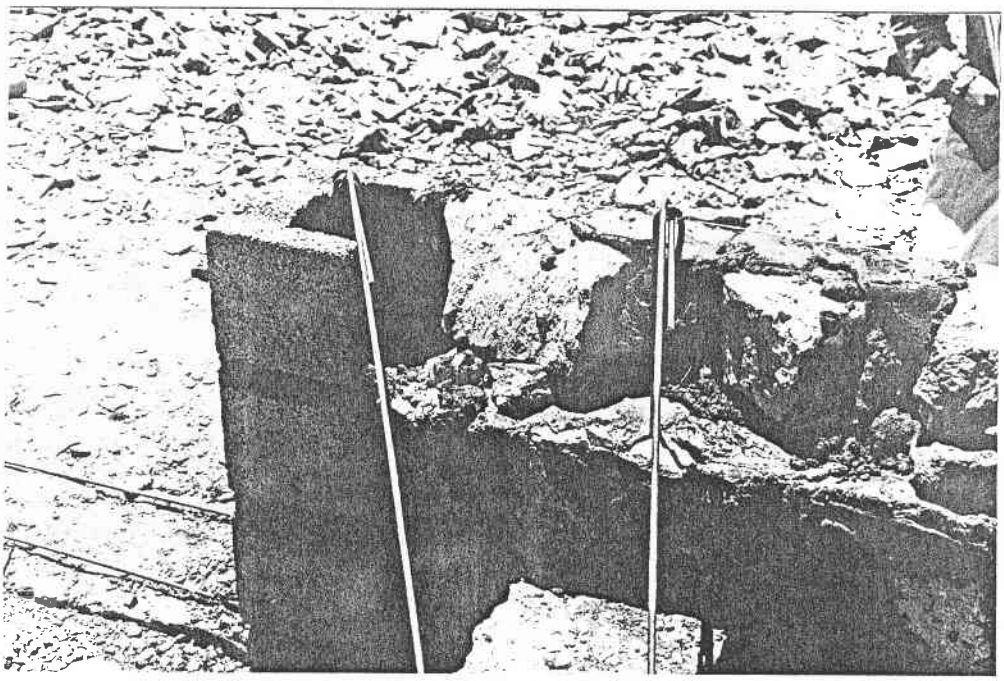




4.2. Vertical reinforcement.

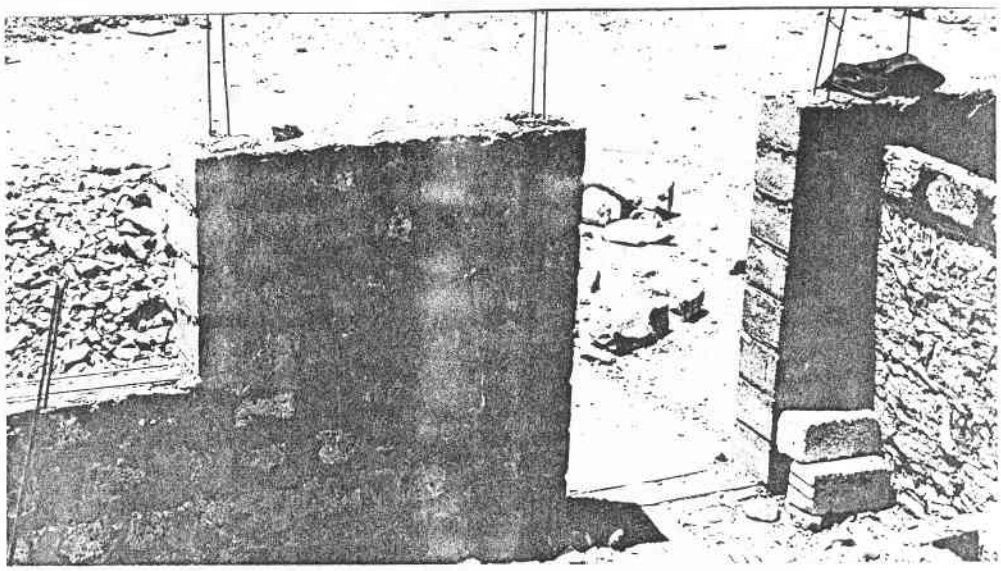
Alongside of all the doors and window openings one or more vertical reinforcement bars were designed. The spacing and the exact positioning of the bars was not maintained. Under the windows no U blocks were used, so the bars were masoned directly into the stone wall, with the fore mentioned disadvantages of contact with the stones.
The following pictures show the first hooks between the two lengths of bars, as well as the grouping together of the two bars.

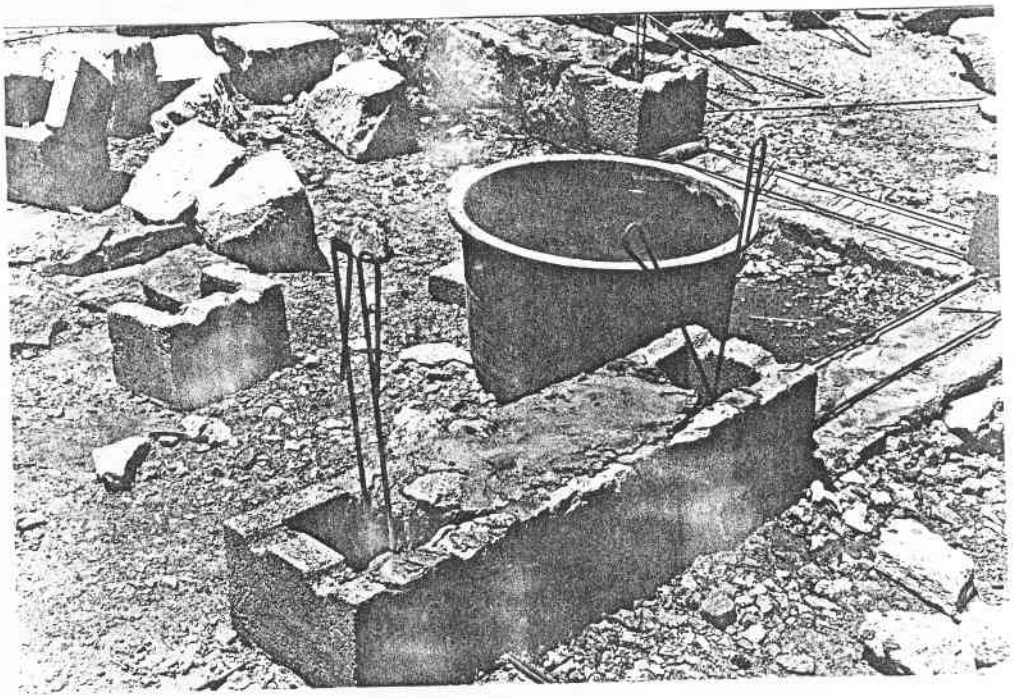




4.3. Horizontal reinforcement.

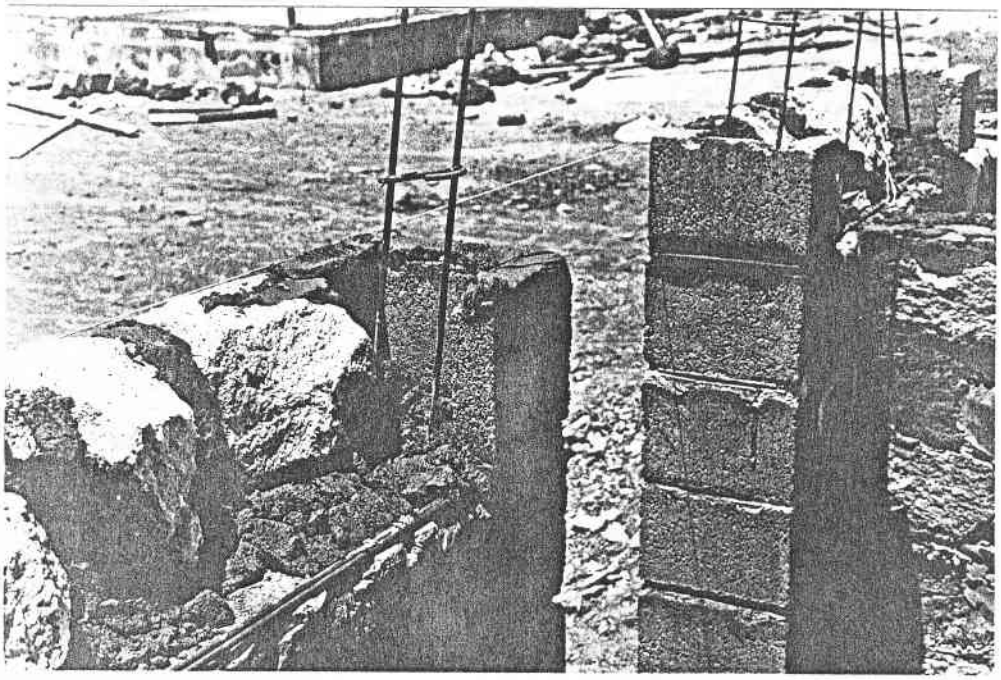
Under the door openings and under the window openings a double horizontal reinforcement was placed, from which the reinforcement under the door openings came directly over the foundation and thus is less useful.
For the making of the openings no temporary frames are used and compared with the other two houses the measurements were kept more exact.
Water was constantly supplied in order to keep wet the masonry work for several consecutive days.

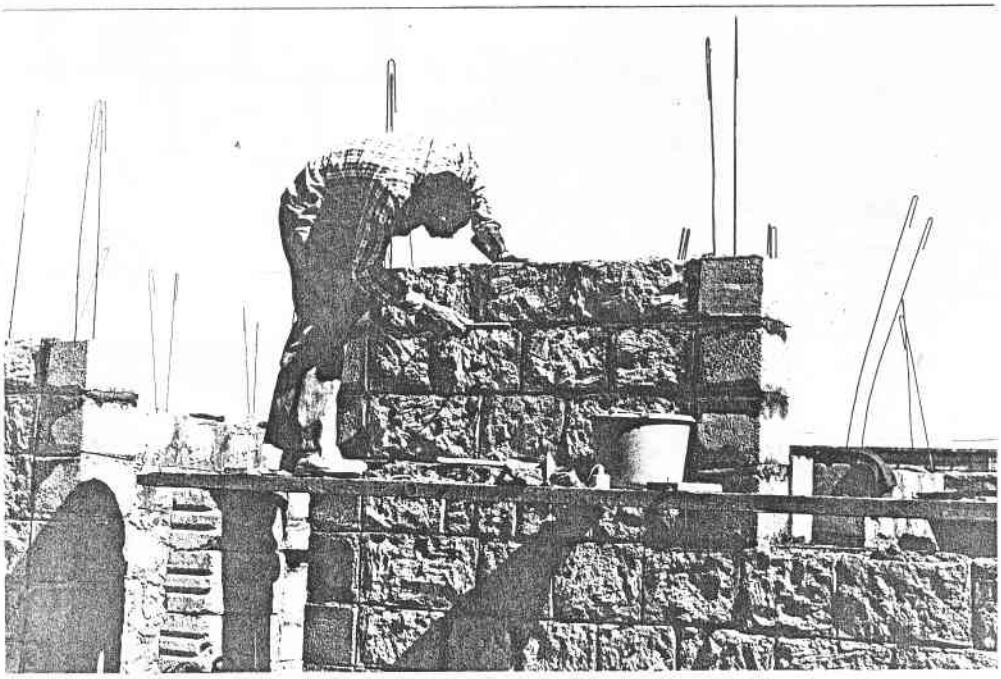




4.4. Cut face stones.

The walls were made with cut face stones although the idea of the project was to used uncoursed layers and through stones as much as possible, as was indicated on the drawings.
One of the main reasons was that at the beginning of the construction nearly all stones were cut into its typical conical way, and for a course thickness of 22cm.
A result of these cut face stones and the 30cm thick walls, is that the inside of the wall was made with many little stones and a lot of mortar.



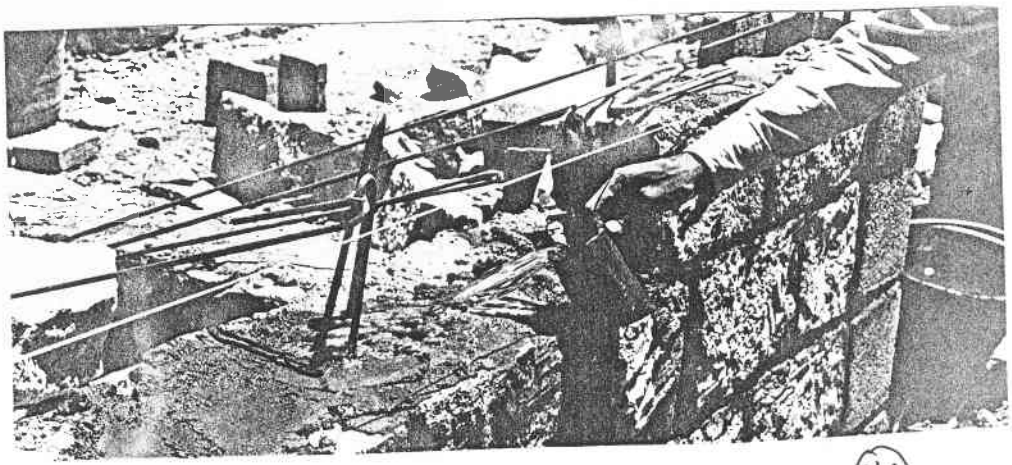


4.5. Watering of the masonry.

The masonry had to be watered during about one full week for the proper hardening of the mortar.
The used tuff stone, absorbs large quantities of water because it is very porous.
First the labourers used the hose or splashed water against the walls. More than 50% of the water (YR25/m3) came on the ground.
When throwing from an altitude also much water splashed away. The best method was to slowly empty the bucket on the top of the wall. Before every course the wall was wetted with the aid of a little tin.

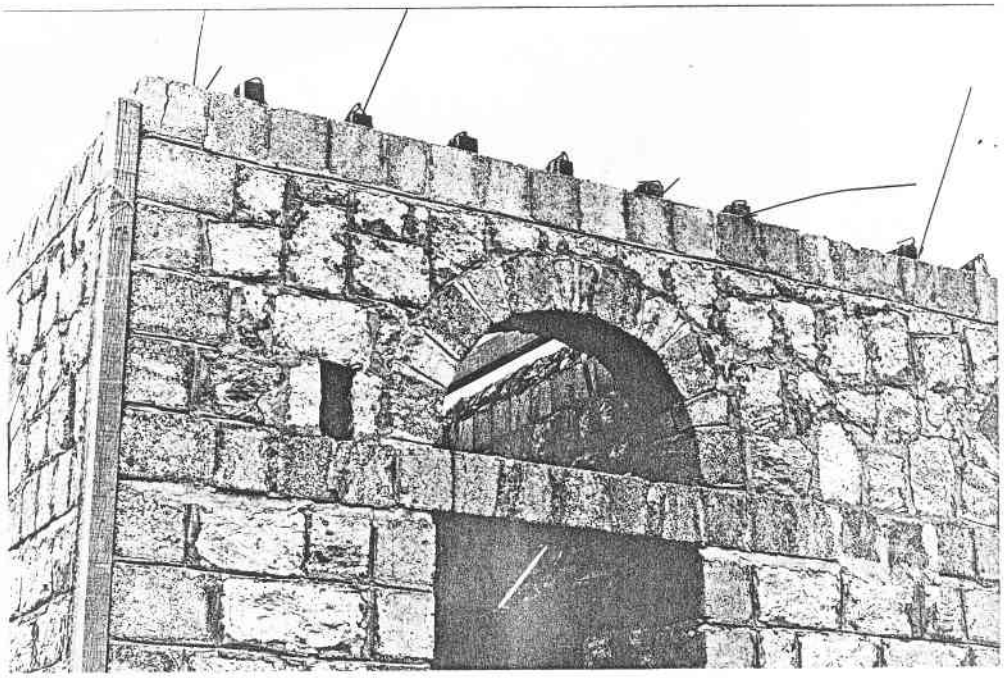
BAD.

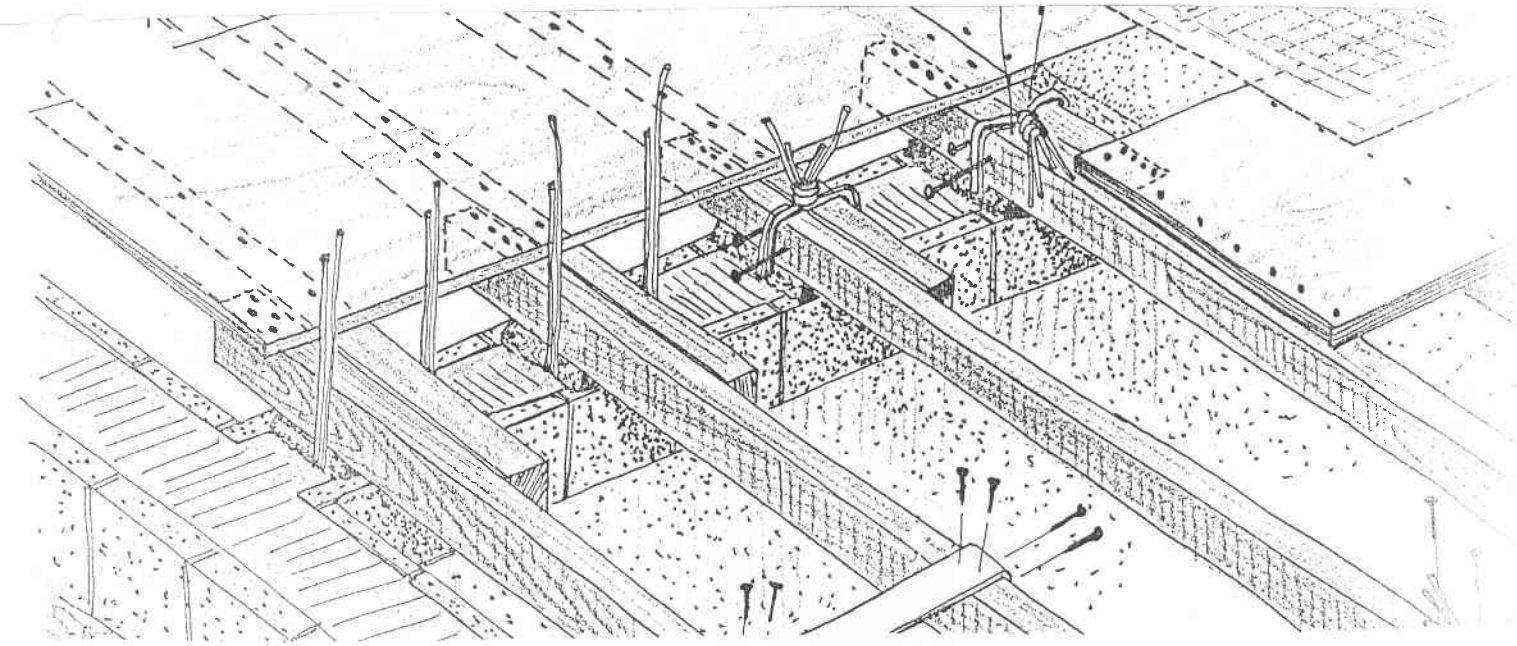
GOOD



4.6. Floor beams.

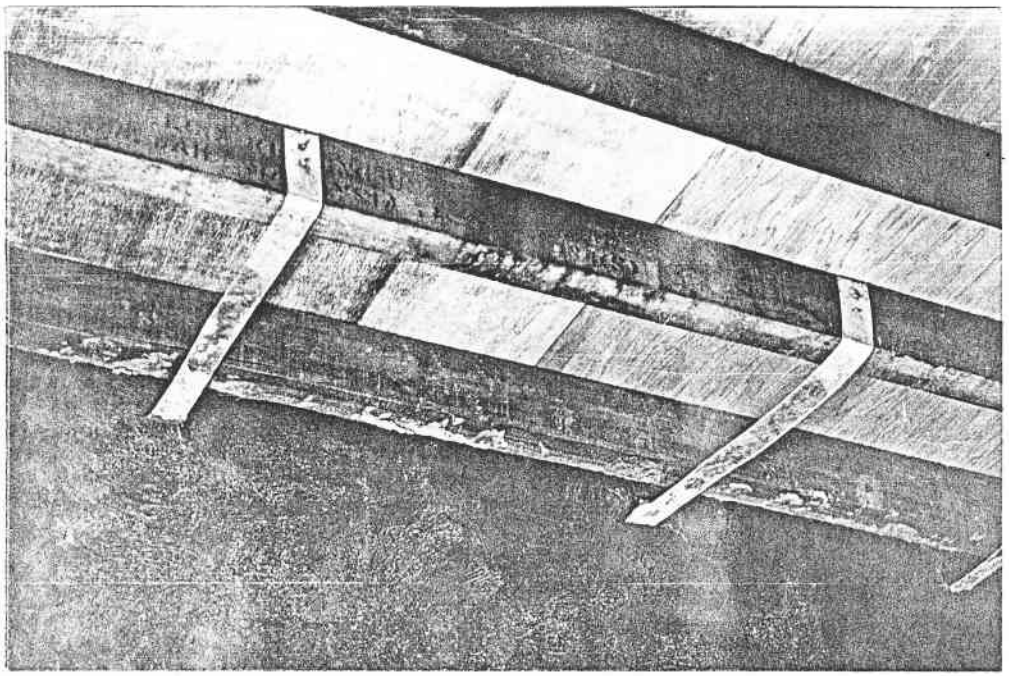
From the lower lintel tie-beam through the upper tie-beam, anchors made of 8mm steel bar where fixed around the floor joists. (6mm was designed but not available in time.) It is recommended in the modelhouse design to use two times 2 mm galvanized wires instead and fix them by twisting and nailed to the joists. The floor joists are hardwood 7 x 12 cm and all nailing was done with concrete nails. The floor joists have a whole wall thickness overlap.
The joists where not cut to length, but the nearest market seizes where used.

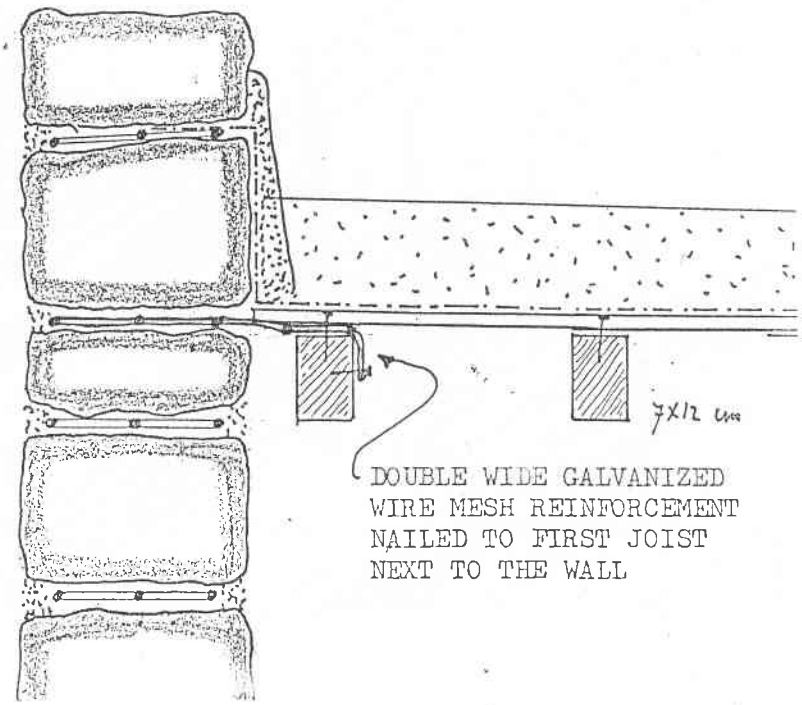




4.7. Horizontal diaphragm.

The side connection of the floor joists parrallel to the wall was achieved by galvanized metal straps, which were cast into the higher tie-beam and nailed with concrete nails to the bottom of the two first beams.
The nailing from the bottom appeared to be difficult and it was suggested to place the steel straps in future between the joists and the plywood. As a furter simplification it is suggested in the modelhouse to apply a double wide galvanized wire mesh in the wall and nail only the first beam to that wire mesh.





5. PRODUCTION OF U BLOCKS.

5.1. Filling of the mould

Before the mould was filled, it was cleaned.
Regularly the metal mould was moistured with water to which a little bit of diesel oil was added.
The aggregate was rather dry and several mixtures were tried out, also the cement content was gradually reduced to 1:7.
The best material showed to be a light weight volcanic coarse aggregate which is widely used for making standard cement blocks.
The mould was hand filled or with a trowel. At the same time the second person was compacting the material into the mould.

5.2. Compacting with weight.

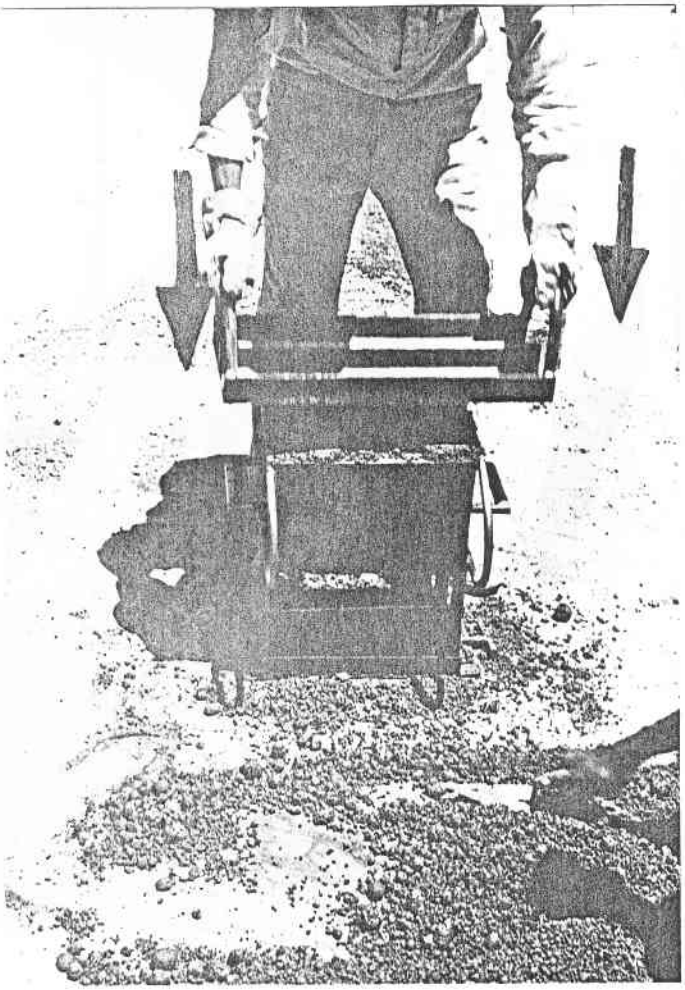
The mould was filled high, with a topping up and than strongly compacted with a 6 kg heavy flat iron.
The compacting is achieved by several blows on the top of the material, thus pressing it into the mould.
The aggregate in the mould should not loose any water or get a shiny surface of the water pressed out of it.
After the first two blows, new material is added to the block by topping up all three sides of the U - block and cleaning the central metal top.

1.

2.

5.3. Second compacting.

After the second topping up, the material is blown again into the mould with three or four blows with the flat iron, until it does not compact any more. Attention must be given to the correct filling of the corners.
With the same flat iron the top of the mould is cleaned and the surplus aggregate material is collected for the next block.
Working on a flat and clean surface is important. On the site a metal sheet was used, which did not absorb any water from the mixed material.
The amount of mixed material was for about 15 blocks, so the sun would not dry out the mixture too fast.

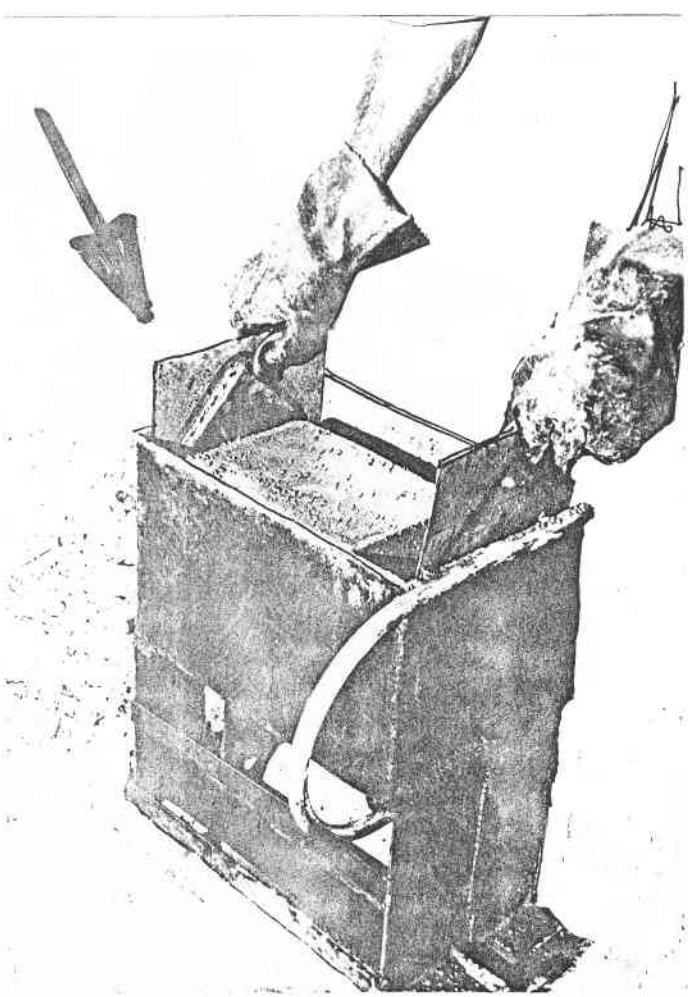


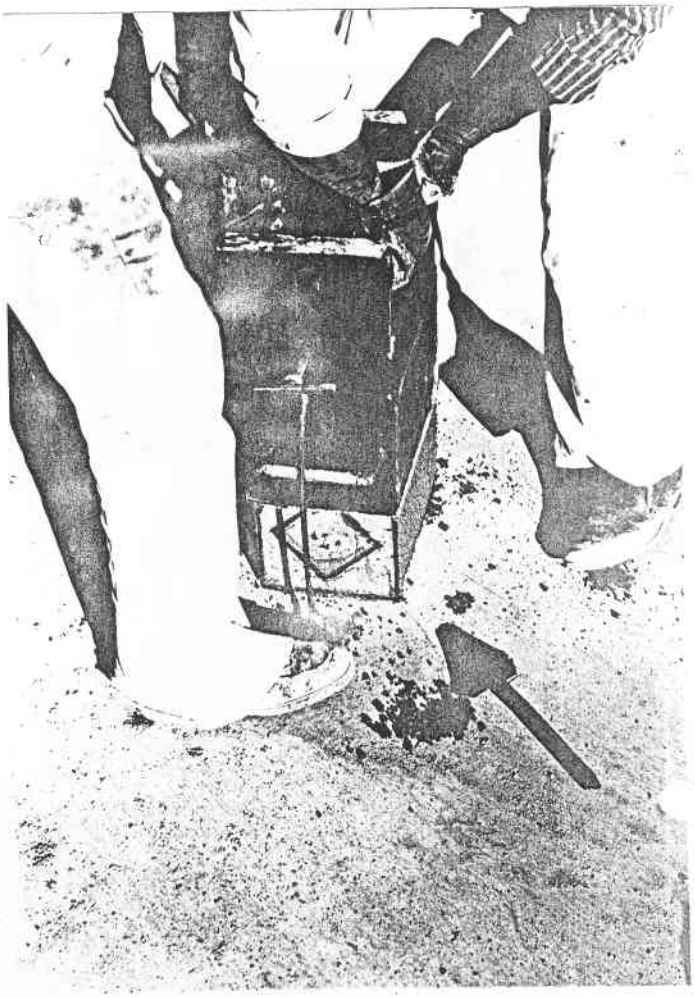
3.

4.

5.4. Decoration on blocks.

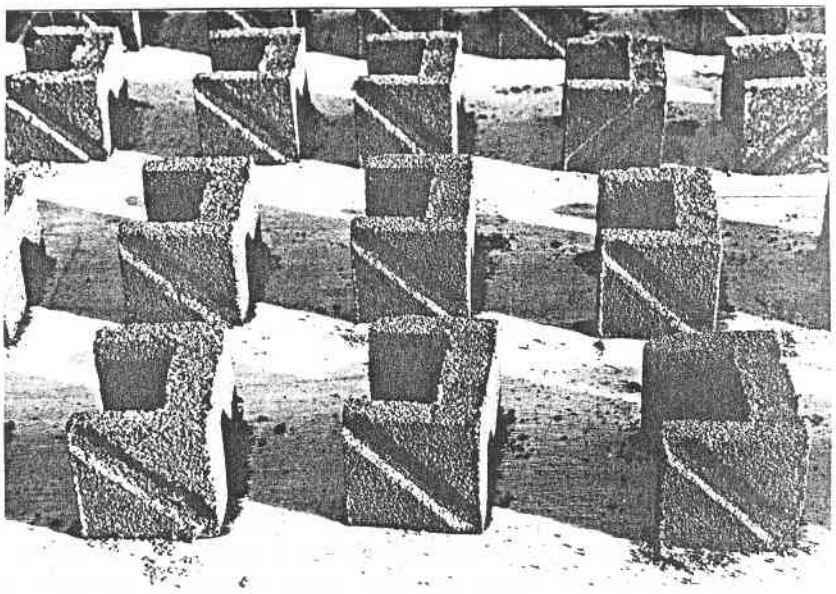
Special plates were made with geometric figures or with letters in order to make decorations in the sides of the blocks. It was found that the depth of the decorations was minimum about half a centimeter. Together with the thickness of the plate about 7 mm - 9mm, depending on the sort of figure. The sides of the U block must have therefore sufficient thickness.
For loosening the mould from the block an extra iron bar was made to hold the movable bottom down when pulling up the mould. This work was done with two persons all the time.

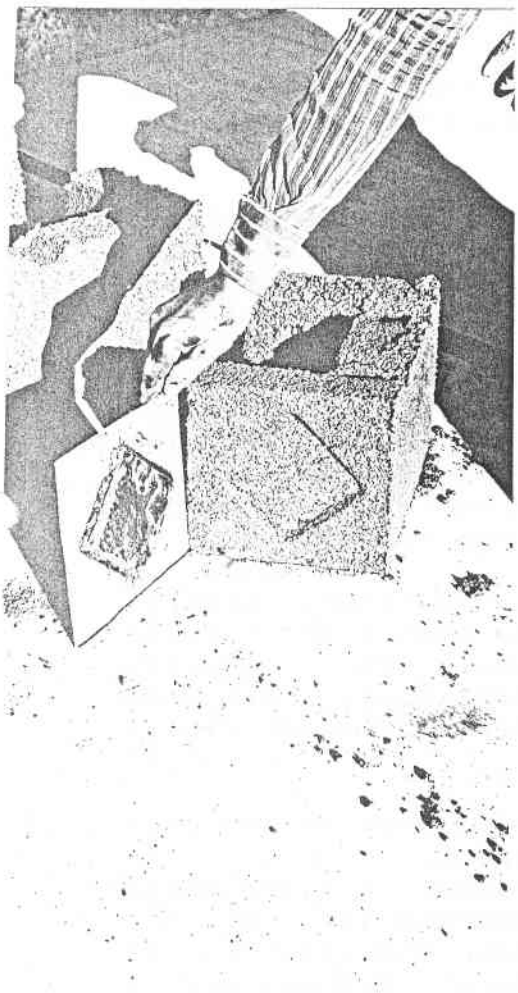


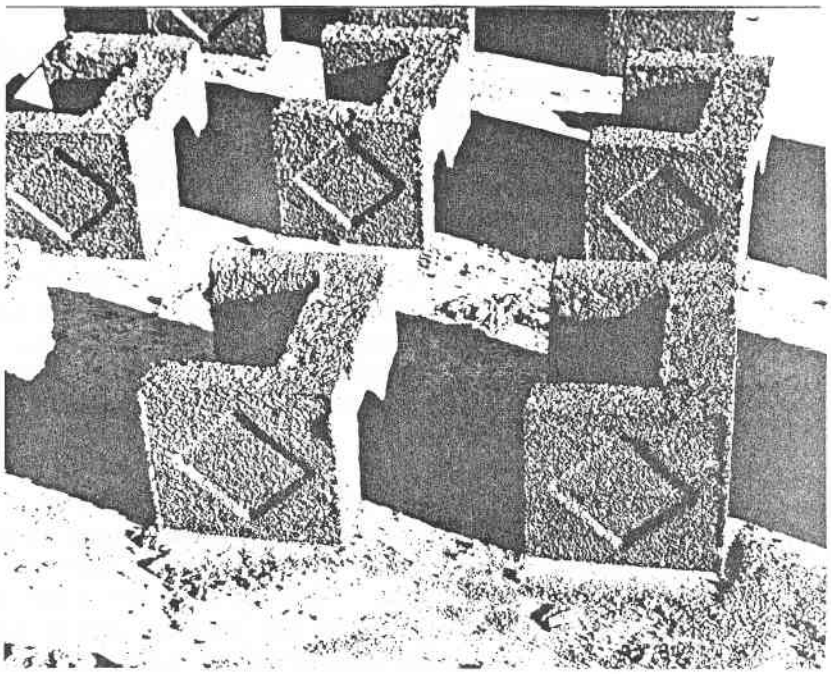


5.5. Mass production of the blocks.

The blocks were demoulded on a platform consisting out of plywood sheets of 12mm thick, which later would be used for the roof construction of the houses.
The daily production of the two labourers was about 80 blocks, considering that the aggregate was machine mixed by themselves.
The blocks were demoulded on plywood, about 6 sheets of plywood of 120cm x 240cm were used.
The next day the blocks were piled 5 high and kept wet for at least one week, twice a day.







6. COST COMPARIZATION OF THE THREE BUILDINGS.

The three tables in the annexe show the final costs of the houses. The costs of the finishings such as plaster, painting, sanitation and electricity are left out.
Modelhouse I is the cement block house of 53 + 25 = 78 m2.
Modelhouse II is the cement block and stone house of 53 m2.
Modelhouse III is the U block and stone house of 53 m2.

The following numbers are referring to the # ACTIVITY numbers of the table.

1) The site preparation includes the cost of the tin sheet building shed and some general cleaning. A surplus of skilled labour was charged to house III.

2) Tracing and excavation from the cement block house was made excessively. As is shown in the pictures the foundations of the second and third house, these foundations were largely simplified and less timber work was made.

3) In the third house the unskilled labour had a larger share than the skilled labour, thus making the construction less expensive.

4) Also here the labour cost is lower in the third house, the reason probably of obtained experience in the former two houses.

5) The masonry of the foundation of the first cement block house is considerable less expensive (YR 150/m2) than the masonry of the other two houses which were made in the hard black stone (YR 250/m2).

7) The masonry of the cement block house in terms of labour is considerably less expensive (YR 58/m2) than the labour for the masonry of the two stone houses (YR 160/m2). The cost of the labour for the masonry of house two is not derictly comparable, because the inside walls of the second house were made with cement blocks with the lower price.

The cost of the local materials of house 1 (cement blocks) including the mortar is lower (YR 80/m2) than that of house two (YR 120/m2), but about the same as the U block house (YR 75/m2). The own production of the U blocks may have had influence on this figure, but the difference is not fully explained as such.

8) The lintel beam of the cement block house was as the beam of the U block house no 3 made with U blocks.
The labour cost was YR 140 and 130/m1 resp., but the price was fixed per m2. The price of the concrete beam of the middle house is based on daily paid labour and came to YR 200/m1. Also the materials for the concrete tiebeam are a bit more expensive.
During the observation during the construction of the two different beams it was shown that the concrete beam required much more attention and labour than the U block beam.

9) The total cost for the masonry of the cement block house is shown to be considerable less expensive (YR 90/m2) than that of the complete stone house (YR 265/m2). Although those figures come close to the figures of point no 7, it is assumed that here a registration error is made considering the differences of cost for the local materials.
The masonry of house 1 was at this level done on daily basis and came to about YR 35/m2 for the labour. This was less expensive than the payment per square meter price (YR 58/m2).

10) The U block tiebeam is here also less expensive than the concrete tie-beam. In reality the U block was less expensive in terms of labour, since the particular mason made relatively many m2 with the beam, compared to other days when normal stone masonry was made.

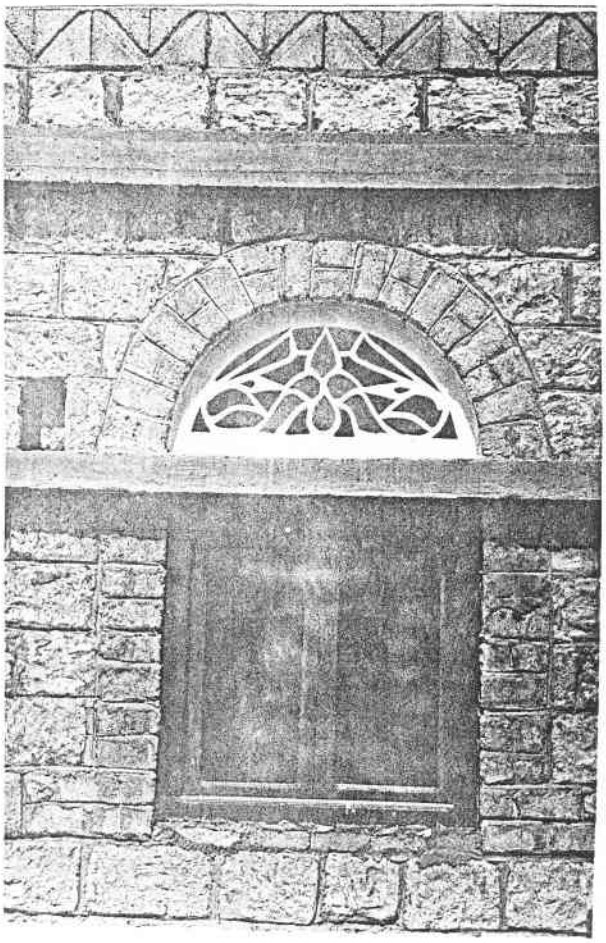
11) The excessive amount of skilled labour on roof 1 was due to the construction of an 8mm steel bar through all the beams on the outer walls and the construction of bolts at the joints on the middle wall.
House 2 was rather cheap because the beams had to be laid in the prefabricated shoes. The shoes are also responsable for the higher cost of local materials.
The large amount of unskilled labour on roof 3 was due to the fact that first the shorter beams of house 2 were laid on house three and than removed.

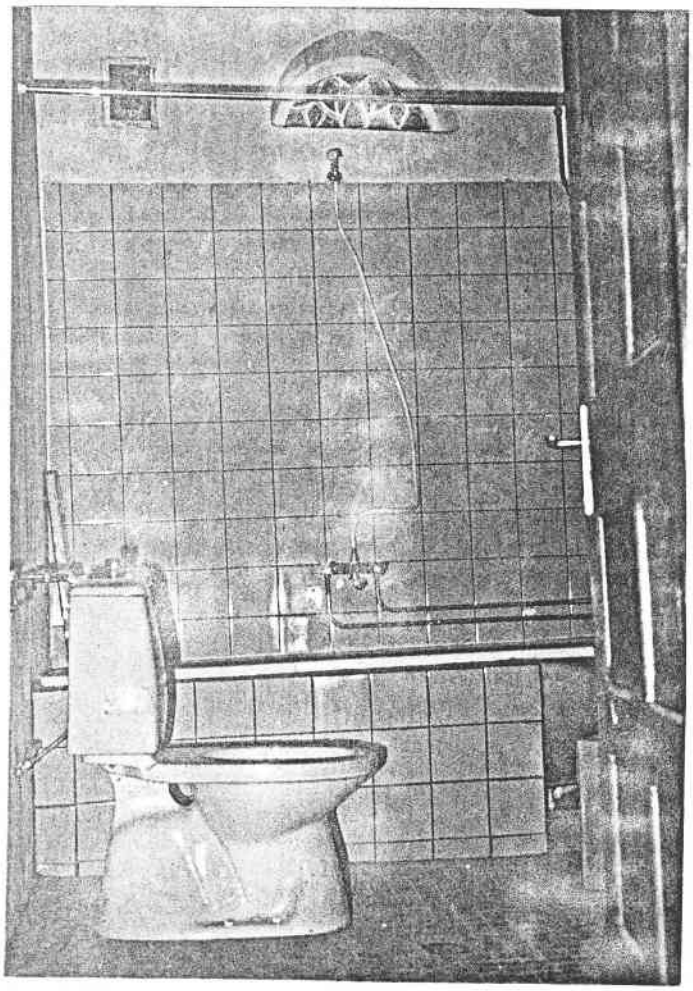
12 and 13) The prices of doors (YR 1000), windows (YR 500) and the Yemeny gypsum windows are about the same of all three houses, however the difference in quality of the three carpenters was significant.

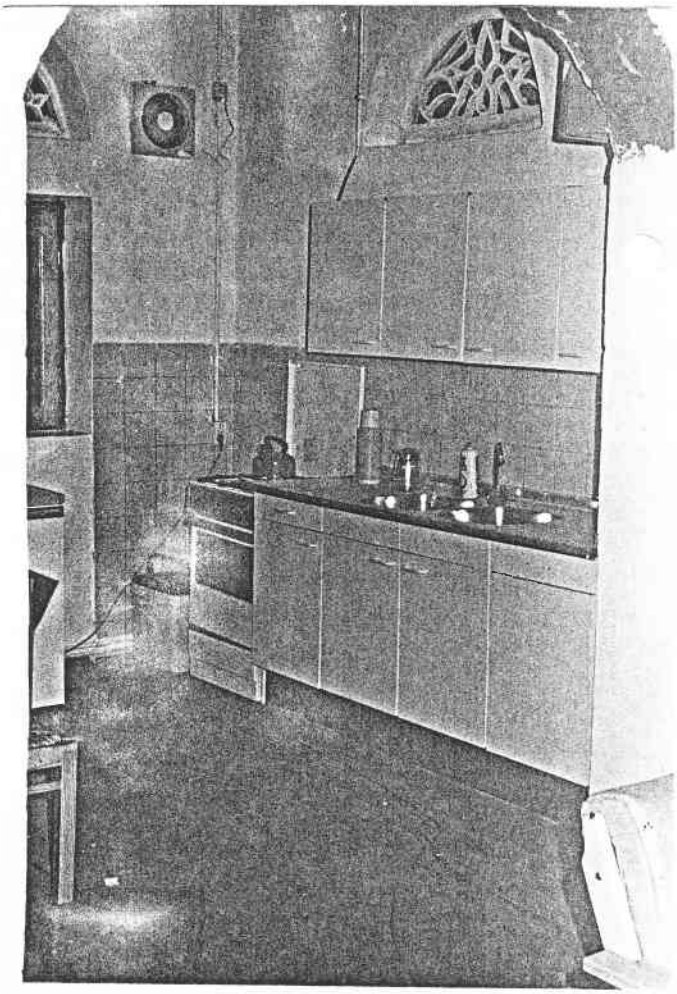
14) The masonry of the last part of the roof is not representative since additional masonry and cleaning was charged to this post.

15) The roof covering of house 1 had the disadvantage of trying out the use of the plastic foil, but it does not really explain the excessive skilled labour cost. THe explanation of excess of unskilled labour of house 2 is also unclear. For the modelhouses no cement will be used, but a smaller amount of lime.

Finishings
The following pictures show some of the interior finishings of the staff houses.







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DHAMAR AIDED SELF HELP RECONSTRUCTION PROJECT
FILE: 3.41.60.62.03
DATE: September 6, 1984
SUBJ: real cost recalculation staffhouses

CEMENT BLOCK HOUSE 53+25=78m2
MODELHOUSE I

#	ACTIVITY	QUANTITY	SKILLED LABOUR	UNSKILLED LABOUR	IMPORT MATERIAL	CEMENT	LOCAL MATERIAL	TRANSP	OTHER	TOTAL
1	site preparation	1 H	770.33	128.00	933.00	0.00	820.00	200.00	809.33	3660.67
2	tracing & excavation	1 H	1127.33	1641.67	0.00	0.00	0.00	0.00	133.33	2902.33
3	footing	2.79 m3	2625.50	410.00	909.00	1800.00	976.33	366.67	54.00	7141.50
4	fill	27.0 m3	262.50	2280.00	0.00	0.00	760.00	150.00	150.00	3602.50
5	masonry	26.1 m2	3812.33	270.00	100.00	600.00	4543.33	33.33	66.67	9425.67
	sub-total stage 1		8598.00	4729.67	1942.00	2400.00	7099.67	750.00	1213.33	26732.67
6	doors/windows frames	15 pcs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	masonry	106.7 m2	6219.00	1703.33	432.00	2400.00	8789.00	150.00	364.00	20057.33
8	lintelbeam	37.0 m1	4386.00	516.67	3737.00	600.00	576.67	0.00	18.00	9834.33
	sub-total stage 2		10605.00	2220.00	4169.00	3000.00	9365.67	150.00	382.00	29891.67
9	masonry	52.3 m2	1739.67	727.00	300.00	1200.00	680.33	156.67	0.00	4803.67
10	tiebeam	0.0 m1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	roofconstruction	67.5 m2	1163.00	560.00	1800.00	0.00	166.67	0.00	0.00	3689.67
	sub-total stage 3		2902.67	1287.00	2100.00	1200.00	847.00	156.67	0.00	8493.33
12	doors/windows	15 pcs	0.00	0.00	0.00	0.00	13000.00	10.00	135.00	13145.00
13	yemeni windows	17 pcs	0.00	0.00	0.00	0.00	3030.00	0.00	0.00	3030.00
14	masonry	39.2 m2	2685.00	0.00	0.00	600.00	1100.00	0.00	48.00	4433.00
15	roof covering	67.5 m2	4313.67	2023.67	3107.00	465.00	583.00	50.00	22.00	10564.33
	sub-total stage 4		6998.67	2023.67	3107.00	1065.00	17713.00	60.00	205.00	31172.33
	TOTAL WITHOUT FINISHING		29104.33	10260.33	11318.00	7665.00	35025.33	1116.67	1800.33	96290.00
16	floor finishing	60.0 m2	350.00	1888.00	0.00	1631.00	898.33	50.00	5.00	4822.33
17	wall finishing	448.6 m2	6897.00	3485.00	3159.33	2260.00	897.00	50.00	72.67	16821.00
18	sewerage	1 H	1768.00	230.00	1287.00	0.00	150.00	0.00	0.00	3435.00
19	water supply	1 H	350.00	298.50	1675.00	0.00	0.00	0.00	120.00	2443.50
20	electricity supply	1 H	2143.33	380.00	6354.00	0.00	642.67	33.33	167.33	9720.67
21	technical installations	1 H	0.00	0.00	15080.67	0.00	0.00	0.00	0.00	15080.67
22	cleaning	1 H	1549.00	1865.83	0.00	0.00	91.00	0.00	218.00	3723.83
	sub-total stage 5		13057.33	8147.33	27556.00	3891.00	2679.00	133.33	583.00	56047.00
	TOTAL WITH FINISHING		42161.67	18407.66	38874.00	11556.00	37704.33	1250.00	2383.33	152336.99

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DHAMAR AIDED SELF HELP RECONSTRUCTION PROJECT
FILE: 3.41.60.62.03
DATE: September 6, 1984
SUBJ: real cost recalculation staffhouses

STONE AND CEMENT BLOCK HOUSE
MODELHOUSE II 53m2

#	ACTIVITY	QUANTITY	SKILLED LABOUR	UNSKILLED LABOUR	IMPORT MATERIAL	CEMENT	LOCAL MATERIAL	TRANSP	OTHER	TOTAL
1	site preparation	1 H	770.33	128.00	933.00	0.00	820.00	200.00	809.33	3660.67
2	tracing & excavation	1 H	889.33	600.00	0.00	0.00	0.00	0.00	113.33	1602.67
3	footing	1.3 M3	2942.33	410.00	909.00	1800.00	1059.33	366.00	54.00	7540.67
4	fill	26.1 M3	262.50	1060.00	0.00	0.00	733.33	150.00	150.00	2355.83
5	masonry	19.7 M2	4797.83	370.00	100.00	600.00	1967.83	33.33	71.67	7940.67
	sub-total stage 1		9662.33	2568.00	1942.00	2400.00	4580.50	749.33	1198.33	23100.50
6	doors/windows frames	9 pcs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	masonry	86.4 m2	10592.67	2442.00	475.00	2400.00	10423.33	150.00	354.00	26837.00
8	lintelbeam	29.0 m1	5191.00	586.67	2004.33	847.50	406.83	0.00	28.33	9064.67
	sub-total stage 2		15783.67	3028.67	2479.33	3247.50	10830.17	150.00	382.33	35901.67
9	masonry	39.4 m2	3549.33	832.00	100.00	900.00	3889.67	157.00	10.00	9438.00
10	tiebeam	29.0 m1	2027.75	1849.00	2004.33	847.50	406.83	0.00	38.00	7173.42
11	roofconstruction	45.0 m2	357.00	368.30	1155.00	0.00	856.67	0.00	0.00	2736.97
	sub-total stage 3		5934.08	3049.30	3259.33	1747.50	5153.17	157.00	48.00	19348.38
12	doors/windows	9 pcs	350.00	0.00	0.00	0.00	8000.00	10.00	0.00	8360.00
13	yemeni windows	10 pcs	0.00	0.00	0.00	0.00	2358.00	0.00	0.00	2358.00
14	masonry	29.5 m2	7257.67	1508.50	0.00	1000.00	1080.00	0.00	38.00	10884.17
15	roof covering	45.0 m2	1261.00	2806.33	2225.00	300.00	713.00	0.00	17.00	7322.33
	sub-total stage 4		8868.67	4314.83	2225.00	1300.00	12151.00	10.00	55.00	28924.50
	TOTAL WITHOUT FINISHING		40248.75	12960.80	9905.67	8695.00	32714.83	1066.33	1683.67	107275.05
16	floor finishing	40.0 m2	875.00	1313.00	0.00	735.00	1278.33	0.00	5.00	4206.33
17	wall finishing	250 m2	3820.00	2010.33	3169.83	4161.00	1298.00	178.00	82.00	14719.17
18	sewerage	1 H	804.00	200.00	1230.00	0.00	112.00	0.00	0.00	2346.00
19	water supply	1 H	1200.00	160.00	1657.00	0.00	0.00	0.00	103.00	3120.00
20	electricity supply	1 H	1957.33	388.00	6314.00	0.00	794.67	33.33	167.33	9654.67
21	technical installations	1 H	0.00	0.00	15080.67	0.00	0.00	0.00	0.00	15080.67
22	cleaning	1 H	3049.00	2783.33	0.00	0.00	7.00	0.00	58.00	5897.33
	sub-total stage 5		11705.33	6854.67	27451.50	4896.00	3490.00	211.33	415.33	55024.17
	TOTAL WITH FINISHING		51954.08	19815.47	37357.17	13591.00	36204.83	1277.67	2099.00	162299.22

ANNEXE

diskette: ????? file: recalMH3.sut
DHAMAR AIDED SELF HELP RECONSTRUCTION PROJECT
FILE: 3.41.60.62.03
DATE: September 6, 1984
SUBJ: real cost recalculation staffhouses

U BLOCK AND STONE HOUSE 53m2
MODELHOUSE III

#	ACTIVITY	QUANTITY	SKILLED LABOUR	UNSKILLED LABOUR	IMPORT MATERIAL	CEMENT	LOCAL MATERIAL	TRANSP	OTHER	TOTAL
1	site preparation	1 H	770.33	128.00	933.00	0.00	820.00	200.00	809.33	3660.67
2	tracing & excavation	1 H	619.00	240.00	0.00	0.00	0.00	0.00	33.33	892.33
3	footing	1.3 M3	1278.33	1270.00	909.00	1800.00	1060.00	366.67	54.00	6738.00
4	fill	26.1 M3	175.00	400.00	0.00	0.00	733.33	150.00	150.00	1608.33
5	masonry	19.7 M2	5122.67	270.00	100.00	600.00	1967.67	33.33	91.67	8185.33
	sub-total stage 1		7965.33	2308.00	1942.00	2400.00	4581.00	750.00	1138.33	21084.67
6	doors/windows frames	9 pcs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	masonry	86.4 m2	13940.75	3070.00	475.00	2400.00	6436.33	150.00	364.00	26836.08
8	lintelbeam	29.0 m1	3848.00	336.67	1959.50	600.00	401.67	0.00	27.00	7172.83
	sub-total stage 2		17788.75	3406.67	2434.50	3000.00	6838.00	150.00	391.00	34008.92
9	masonry	39.4 m2	5675.00	2315.33	100.00	1395.00	821.33	156.67	0.00	10463.33
10	tiebeam	29.0 m1	2438.00	450.00	1959.50	600.00	401.67	0.00	0.00	5849.17
11	roofconstruction	45.0 m2	357.00	1550.00	1330.00	0.00	166.67	0.00	0.00	3403.67
	sub-total stage 3		8470.00	4315.33	3389.50	1995.00	1389.67	156.67	0.00	19716.17
12	doors/windows	9 pcs	0.00	0.00	0.00	0.00	7600.00	10.00	0.00	7610.00
13	yemeni windows	10 pcs	0.00	0.00	0.00	0.00	2346.00	0.00	0.00	2346.00
14	masonry	29.5 m2	4910.67	2420.67	0.00	1200.00	825.00	38.00	38.00	9432.33
15	roof covering	45.0 m2	1400.00	1799.33	2362.00	300.00	533.33	0.00	17.00	6411.67
	sub-total stage 4		6310.67	4220.00	2362.00	1500.00	11304.33	48.00	55.00	25800.00
	TOTAL WITHOUT FINISHING		40534.75	14250.00	10128.00	8895.00	24113.00	1104.67	1584.33	100609.75
16	floor finishing	40.0 m2	750.00	553.33	0.00	900.00	993.33	0.00	5.00	3201.67
17	wall finishing	250 m2	3990.00	1057.00	3159.33	2796.00	600.00	90.00	61.00	11753.33
18	sewerage	1 H	438.00	200.00	1241.00	0.00	75.00	0.00	0.00	1954.00
19	water supply	1 H	1200.00	80.00	1657.00	0.00	0.00	0.00	90.00	3027.00
20	electricity supply	1 H	1957.33	592.00	6314.00	0.00	925.00	33.33	167.33	9989.00
21	technical installations	1 H	0.00	0.00	15080.67	0.00	0.00	0.00	0.00	15080.67
22	cleaning	1 H	2299.00	1966.67	0.00	0.00	7.00	0.00	58.00	4330.67
	sub-total stage 5		10634.33	4449.00	27452.00	3696.00	2600.33	123.33	381.33	49336.33
	TOTAL WITH FINISHING		51169.08	18699.00	37580.00	12591.00	26713.33	1228.00	1965.67	149946.08

END FILE