

TRAINING WORKSHOP FOR BUILDERS

Contents

1. Introduction	Page 42
2. Methodology	47
3. The Workshop	48
4. Drawing, designs and building methods	
5. Technical and practical content of the Workshop	51
5.1 Overall approach	51
5.2 Site evaluation	51
5.3 Foundations	52
5.4 Walls	53
5.5 Renders	57
5.6 Openings	58
5.7 Roofs	58
5.8 Specific subjects related to Seleleh	61
5.9 Conclusion and continuation	63

TRAINING WORKSHOP FOR LOCAL BUILDERS AND ARTISANS.

BUILDERS WORKSHOP IN YAZD, CENTRAL IRAN

1 Introduction

The main basis of the approach taken by the Selseleh Integrated Development Project was aimed towards improving the living conditions within the region through active participation of the community and by the use of local resources.*

The four major activities of the S.I.D.P. lay in the fields of education, health, agriculture and physical services. These four activities were introduced through education, so that, while the immediate needs of the four aspects were being met, the local population were at the same time being trained to provide these things for themselves, and to eventually cease relying so heavily upon others to help them.

At the start of the S.I.D.P. work, 90 volunteers from the region were chosen and given a broad training in agriculture, health and education (initially primary and literacy education). After the basic training period these people were sent back to their villages where they could work with the local people to improve conditions in the area.

Because of the pressing needs for new facilities in the area, even though there was an extreme shortage of even relatively skilled builders, it was not possible to begin with a comprehensive builders training programme before starting on practical building work. Training had to take place whilst building was going on. Because of the impossibility of supervising every building site constantly, a number of bad building practices were incorporated into the earlier buildings. This was understandable given

* The Development Workshop were the architects and planners for the SIDP from 1975 to 1978.

the largely nomadic background of the people, who, unlike much of the rest of Iran, did not have a long and rich tradition of building to develop from.

In general, the 'builders' suffered from a combination of difficulties; lack of experience, skill and pride in their work.

At the time that the Builders training workshop was organised, some participants had been working in agriculture less than a year before. One had been and periodically continued as, the assistant cook in the S.I.D.P. canteen.

All the participants had one thing in common; the desire to learn and improve their buildings skills. Lack of pride in their work was primarily an expression of the low standard that had been accepted in the past. There had been very little exposure to work of good quality.

The building season in the Selseleh Region is between April and November. Buildings must be weatherproof by the time that the main rainy season begins. Interior work can carry on for a while, but by the end of December the weather becomes so cold that materials freeze and much of the work is slow and unproductive. Any training programme that was not to interrupt the scheduled building programme had to take place between December and April, when the participants could be involved entirely in training.

The first obstacle to be overcome was the location for the training workshop. The training required outdoor space that could be used for practical work and experimentation. Selseleh was unsuitable because of the winter climate.

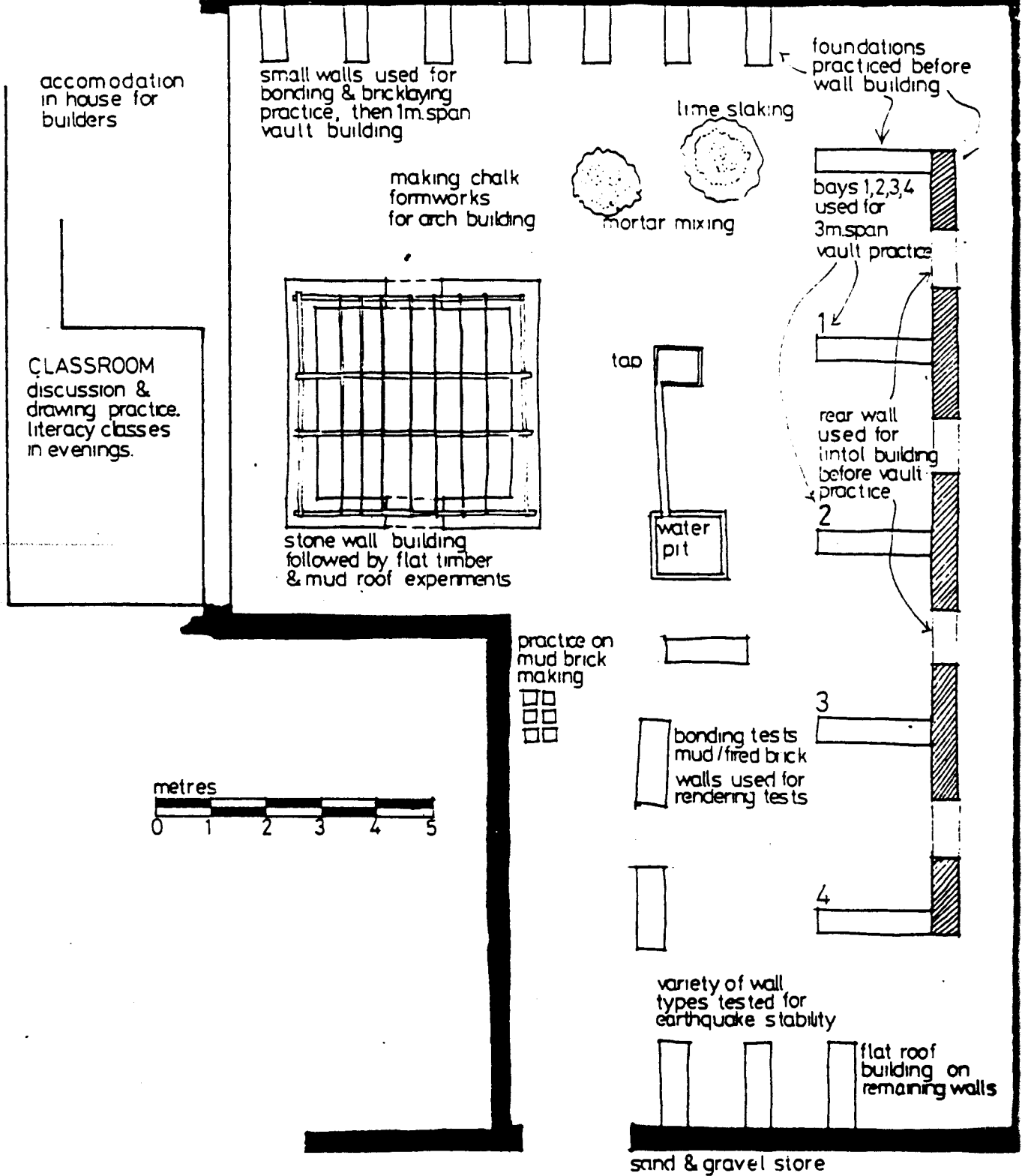


Fig 2 LAYOUT OF BUILDERS' WORKSHOP

There were two closely inter-related aims in the workshop; firstly to develop indigenous building methods through the pooled knowledge of the participants; and secondly to train the village builders in practical and organisational skills so that they were equipped to meet most rural shelter needs without dependance on city based contractors, engineers and building materials.

The workshop was not, however, a conventional teaching process. Each aspect of the programme was based upon the sharing of experience amongst all the participants. This experience was discussed and the best solutions to meet the needs and potentials of the Selseleh area were collectively decided upon. Each solution was tested and developed through practical work in the courtyard. It was stressed from the beginning that, whilst some of the participants had greater knowledge than others, each person had something valuable to contribute. In practice, as many valuable suggestions came from people who had no specialised background in building as came from those who had been trained, i.e. the master masons and the members of the Development Workshop.

The builders from Selseleh had an invaluable understanding of what could or could not be done in their own region. Without this, some ideas could have been developed without being entirely suited to the local conditions.

2 Methodology

The methodology adopted for the workshop was: learning through discussion, through practice and through experimentation. As an additional part of the workshop, basic literacy classes were conducted in the evenings, since the majority of the builders were illiterate. These literacy classes were directly related to the subjects being

dealt with in the workshop, and consequently took on a greater degree of relevance to the day to day life than was normal. Certain aspects of the workshop programme clearly demonstrated the need to be literate, most particularly the ability to read architectural drawings and understand their basic requirements; and to be able to organise the building process - ordering of materials, accounting etc. These skills were important if the builders were to take on Government contracts in Selseleh.

3 The Workshop

Before any practical discussion was to begin dealing with building in particular, it was important to establish an understanding of what sort of approach should and could be taken in the development of the Selseleh Region.

The builders were asked to identify the negative and positive aspects of the Selseleh area. Having listed the resources/potentials and shortages/problems in the area, they were then asked to see to what extent the resources could be used to overcome the problems in the area. Because of their background, many of the ideas related to the agricultural and animal husbandry. Through the discussion a strategy for the practical development of the Selseleh Region was developed which included ways of increasing employment, through the establishment of workshops, for metal, handicrafts, woodworking etc., and kilns, for producing bricks, chalk and lime, all of which were locally available. They also identified certain essential facilities which could and should be provided - new roads, public buildings, work places etc., and the extent to which the people of the area could do this themselves and what role or assistance the Government needed to provide to supplement their own potential. One of the major difficulties was the shortage of capital required

in establishing many of the things required in the region, and this was seen as a major area of needed assistance. However they felt that by stimulating the local economy, they would be increasingly capable of improving conditions in the region without assistance. The builders suggested that the poor quality of the built environment in the area was mainly a reflection of the economic poverty of the area, and illustrated this by saying that if there was more money in circulation, more people would be able to afford better materials, and to improve the use of existing materials.

More detailed discussion dealt with the provision of public facilities, looking particularly at the role of the Government and its relationship with the village community. The builders felt that the best results occurred when village financed and participated in the process, but that this was seldom possible because so little money was available. On the other hand, when the Government provided a building, its design and operation seldom met the specific requirements of the village and its environment, and the people tended to neglect the building after completion. The suggested solution was through participation of the people and the help of the Government, where the future users would be involved from the beginning, from decision making through to use and maintenance, and could harmonise the building to their needs.

For such a strategy to work, it was essential that the builders could read and interpret architectural drawings, so that they could take on Government work in the area and produce simple plans for the local buildings.

4 Drawing designs and building methods

The discussion on drawing, design and building methods was introduced by asking the builders to draw their own

homes. Whilst these initial drawings were in many cases not very clear, they provided the basis for discussion of buildings with which they were already familiar. With these buildings, basic principles of design and construction were illustrated; for example, the positioning of windows in relationship to the building's orientation. A stereotyped cardboard model was made, with which the different views of the standard house in Luristan could be seen in terms of plans, sections and elevations, by removing parts of the building. (Fig. 3)

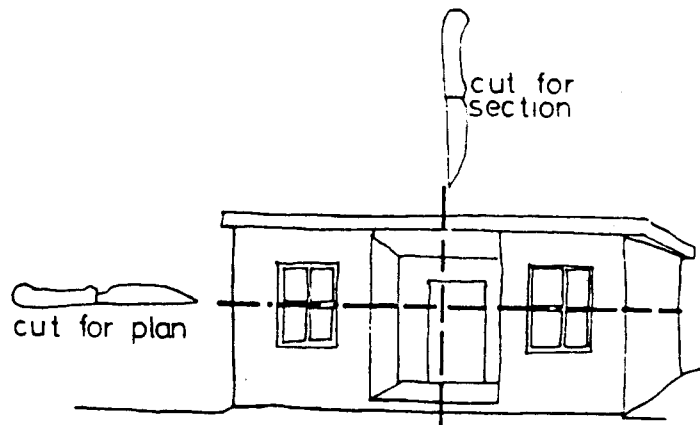


Fig 3 CUTS ON MODEL

Through this the builders quickly developed a basic ability to produce more accurate drawings. Methods of dimensioning their drawings and using scales, i.e. 1:100, 1:50 were introduced.

5 TECHNICAL AND PRACTICAL CONTENT OF THE 'WORKSHOP'

5.1 Overall approach

The various elements of the building were dealt with from the ground upwards. At each stage the basic requirement was discussed, including the principles involved, and from this analysis, a variety of solutions were investigated. Those that seemed suitable for the Selseleh Region were practiced on in the yard, with demonstrations of the correct or best method.

The detailed programme of the workshop was along the following lines: Each new subject was introduced and its function explained. The builders were asked to describe the methods that they were acquainted with. Members of D.W. or others with specialised knowledge, added information where necessary which was also analysed. The most suitable methods were selected and the group moved to the practice yard where the ideas could be demonstrated and experience gained in how each stage of the building should be done.

In addition to basic building techniques, certain specialised subjects were dealt with, In this case, because Luristan has a high incidence of earthquakes, special attention was paid to the introduction of earthquake resistant features in building and the principles explained.

5.2 Site evaluation

It was explained that before positioning the building, one should find out whether there were any features in the site which might affect the type of structure or the future performance of the building. These could be simply investigated by observation, to note evidence of flooding, marshy ground, rubbish tips, the proximity of trees etc.; and by physical investigations, which basically meant

digging trial holes to find out what the ground was like, the height the water table, etc.

All of these could influence the location of the building and the type of foundation used.

Later on in the programme simple methods were demonstrated for analysing soil types. At this stage the behaviour of different soil types was explained.

5.3 Foundations

The Function of foundations was discussed, and the builders described the method they knew. It was pointed out that many buildings in the area did not have proper foundations, and that where used, the method of building the foundations was often poor. The discussion stressed the importance of having properly built foundations since the whole weight of the building rested on them.

Practical demonstration focussed upon two foundation types suitable for small buildings of less than 2 storeys, one for firm and stable ground and the other for unstable ground.

In Selseleh, the accepted materials for foundations were lime and earth for the mortar (Shefte), and stone. The lime used in the mortar was not always slaked before mixing, which resulted in cracking when the lime came in contact with humidity in the soil. It was stressed that lime should always be soaked in water before use.

Stones were usually thrown into the foundation, with no attention paid to laying them properly. This too resulted in weak foundations. The correct laying of stones was demonstrated and practiced.

5.4 Walls

The builders were asked to describe the various functions of walls in a building. Their answers were comprehensive and included the following requirements:

- to be able to support own weight, roof load and snow.
- to provide shelter from undesirable climatic effects i.e. rain, snow, sun in summer.
- to provide security
- to make a boundary for the family
- to keep noise out
- to have stability against earthquake, flooding and other accidents.
- to be fire resistant.

Ways of meeting these requirements were discussed and the various wall types used in Selseleh were considered, both in terms of how they performed and how they could be improved.

- a) Packed Earth walls (Chineh). The simplest and cheapest of the walling types used mud and straw, placed in lumps on the wall so that the wall is built up in 50 cm layers. The strength of these walls was low and two suggestions were made 1) that a ram and form-work could be used so that the mud would be compacted and have a greater load bearing capacity. 2) That improved water resistant renders should be used to stop surface deterioration.

Both these suggestions were developed upon through practical test walls.

There was a general consensus of opinion that these walls were not very strong and that where possible alternative wall building systems should be used.

They were regarded as being satisfactory for building perimeter walls to courtyards. (This was probably the

Common faults in bricklaying were identified and, after discussing the reasons why, the correct method was demonstrated and practiced upon.

These faults included: 1) Using incorrect mortars. Various mortars were experimented with. To achieve a balance between cost and efficiency, a lime/Sand mortar was agreed upon as being satisfactory for most situations in Selseleh.

2) Bricks should be dipped in water before laying to improve adhesion.

3) Bricks were usually laid with no mortar between vertical joints. This practice lead to weak walls and was to be avoided.

4) The pattern that bricks were laid in seldom incorporated any proper bonding, either through the brick from one face to the other, or between one horizontal course and the one below it. The practice of filling in the middle of walls with broken bricks in order to save money was discouraged. The participants of the workshop practiced on various types of bonding patterns.

5) Because it was easier, a common practice was to build up walls at either end, and then fill in the wall between afterwards. This produced weak corners which fail in earthquakes, and the builders were encouraged to complete one course at a time.

Some of the builders knew how bricks should be laid, but had seldom bothered. It was stressed that, by taking care and attention at each stage of the building, the finished product would be of better and stronger quality.

d) Stone walls. Many houses in Selseleh had stone walls but these were usually of the 'rubble stone' type,

held together with mud mortar. Where cement or lime based mortars were used, the quantity of mortar was often greater than stone, producing extremely expensive walls. A skilled stone mason from the mountains south of Yazd was invited to come and talk about and demonstrate how stones should be used in wall building.

By first observing then participating, the builders could compare how they had been using stone with the way that was being demonstrated.

As in fired brick walls it was important with stone that the individual units should be laid so that there was proper bonding in the wall. There should be a stone laid through the wall to at least $\frac{1}{3}$ of its width every 1.5 metres. Larger stones should also be used round doors and windows and at all corners. Most of the builders had been accustomed to using stones unselectively. The stone mason showed them how to select a stone and position it so that it fitted as closely as possible into its position. In this way much less mortar was required and money would be saved.

In the period that followed the training workshop, one of the most noticeable improvements was in the quality of the stone wall building.

5.5 Renders

Because many of the walls used in Selseleh had poor resistance to rain, a number of experiments were carried out on different and improved types of rendering mixtures. By comparing these with the mixtures normally used, the builders selected several that they felt were applicable and could be easily used.

Renders using bitumen and emulsifiers were the most acceptable, since the raw materials were readily available and both easy to mix and apply.

As an essential part of these experiments and the selection of the right materials for mud brick making, simple methods of soil testing were introduced. By placing a sample of the soil in a bottle or jar, adding water and then allowing the contents to settle, one could get a good indication of the type of soil, how much sand and how much fine silt or clay it contained. Having explained the proportions of sand to clay that were desirable for brick making, from this test the builders could decide whether the proportions needed to be altered.

5.6 Openings.

Discussion first of all dealt with the position of openings in a building, in relation to climate and earthquakes, and their function and then the methods for making lintels. These included timber and steel lintels; it was stressed that the material spanning an opening should extend well into the walls on either side. Various types of arched lintels were investigated, ranging from almost flat arches to semicircular, and different types of arch were built. One of the builders suggested a combination of wood and bricks which was also built producing an almost flat lintel. Practice also included making formwork with chalk for use in arch construction.

5.7 Roofs

Because the programme was geared towards the needs of the Selseleh Region, two types of roofing were discussed and developed upon.

a) Flat timber roofs. This was the standard roof of the region, used in nearly all building. The builders

Because this type of roofing was particularly applicable to public bath and high fire risk building in Selseleh, but was no longer a local skill, the Yazd master masons, who were skilled in this technology, were asked to explain and teach the method of vault building. In discussion, the various spans and relevant wall thicknesses required to support vaults were explained, as well as the basic principles. Practice (Fig 5) was initially on small 1 metre vaults, from which the builders progressed to 3 metre spans. Visits were also made to various domestic and public buildings in Yazd, where vaults and domes are the most common roofing method. The builders could see a wide variety of spaces covered simply and efficiently. They requested that some of the more complicated vault systems should also be demonstrated, to allow them to compare these with the method they had learnt.

- 5.8 Towards the end of the workshop programme a series of discussions were held on various subjects related to Selseleh and to the organisational skills that the builders would need when operating independently in the future. The effects of earthquakes on building were outlined, and followed by ways in which the building could be made to withstand them. Many of the principles outlined during the workshop were involved in this: bonding in walls, positioning of openings, roof construction, but overall emphasis was put on always building with care and precision.

Discussion also covered the organisation of the workforce on the building site, ordering and estimating for materials and equipment, and costing and keeping records. These were all skills which would be developed further after returning to Selseleh to build.

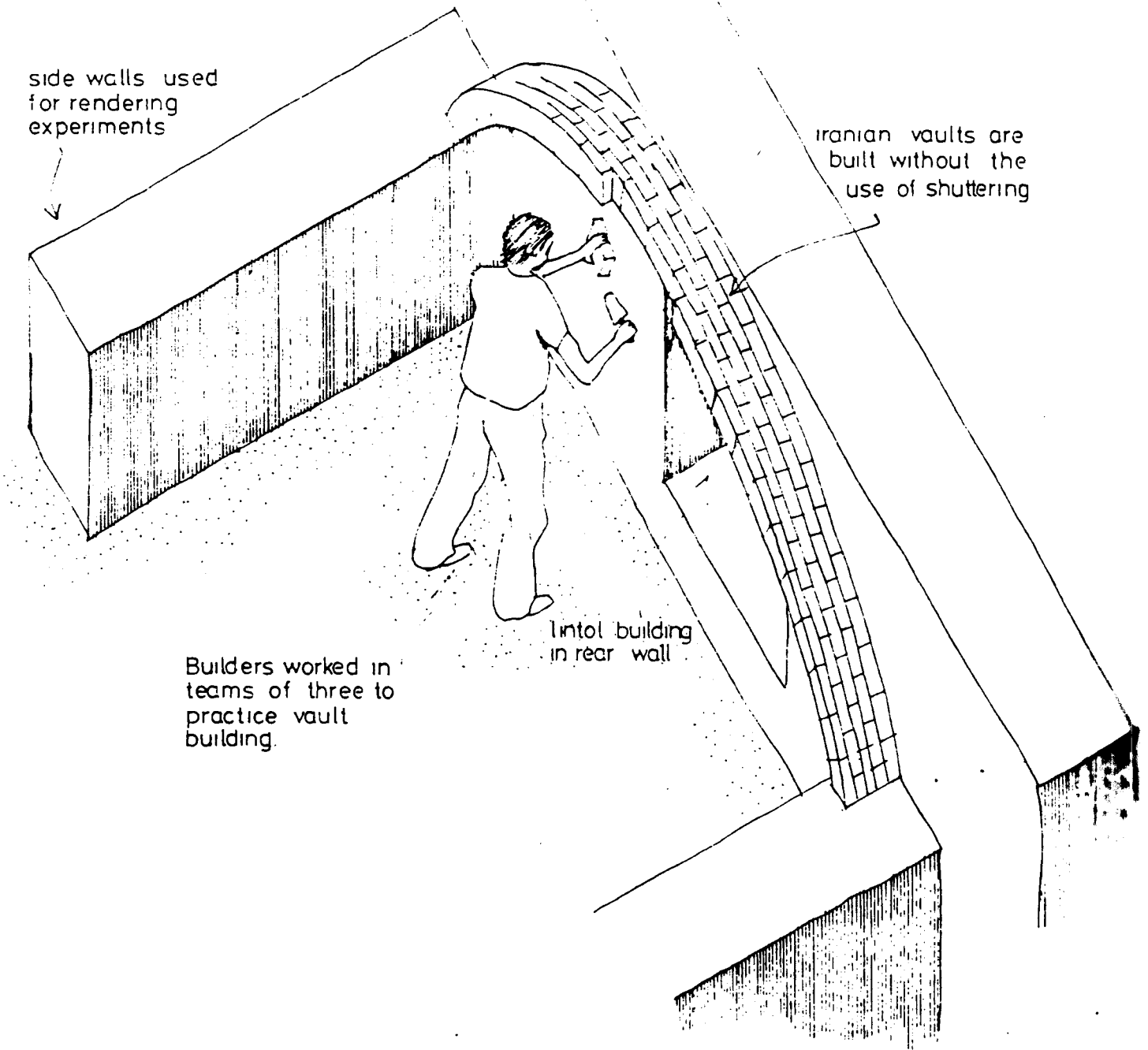


Fig 5 THREE METRE SPAN VAULT BUILDING
Each area was used for other practice
exercises as well.

described the local method: placing poplar tree (Tabrizi) beams, usually three per metre, over which boards were laid. On top of the boards, cardboard was used to seal any gaps in the boards. This was covered by 15 cms of compacted earth. Where money permitted, covering layers of cement, hessian and bitumen were used to provide a proper waterproof finish. The depth of compacted earth, which in the villages provided the waterproof layer, was not reduced when cement and bitumen were added on top.

The weight of such roofs was considerable. Suggestions were made to reduce the number of expensive large timber beams, and to use instead fewer main beams supporting smaller, and considerably cheaper, subsidiary beams. (Fig.4)

Two experimental roofs were built to develop and show this idea in practice. Wall plates were also used to tie the beams together and fix them to the walls. This was important in an area subject to earthquakes, since failure of buildings often occurred when the roof fell off the walls. (Fig.4)

Whilst the Selseleh region received considerable rain and snow fall during the winter, roofs were seldom laid with any slope. Drainage off the roof relied on piling up the earth on the roof at one end, which increased the weight and was not very effective. This could be simply resolved by laying the beams at a gentle slope, hence reducing the amount of earth needed and the consequent weight.

- b) Vaulted Roofs. The Iranian system of vault building with fired brick, mud brick or stone needs to use no shuttering during the construction process, avoiding a wasteful use of material.

5.9 Conclusion and Continuation

The workshop was not seen as a finite process, but instead the beginning and establishment of an educational methodology which the builders could use to further develop themselves and their indigenous methods. This was based upon identification and problem solving, and by sharing each others knowledge. The process of discussion, practice and experimentation was carried over into the ordinary building work in the Selseleh Region.

The range of subjects and skills introduced in the workshop was broadened in the practical work that followed.

Because of the builders' improved capability, it was possible to devolve to them a large amount of the responsibility for the building requirements in the Selseleh Region. With this responsibility came the need to find more people to assist them in meeting the building needs of the area. Just over a year after the initial Builders Workshop programme, the original builders organised a second workshop to go over what they had learnt and to pass on the knowledge to a new group of trainee builders.