PRIMARY SCHOOL CONSTRUCTION IN SIERRA LEONE

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THE ROLE OF SELF-HELP

A REPORT PREPARED FOR THE GOVERNMENT OF THE

REPUBLIC OF SIERRA LEONE AND THE WORLD BANK/IDA

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INTRODUCTION

This report is the result of studies carried out between 1985 and 1988 by the author whilst working for the Sierra Leone/IDA Education Project Unit as Education Building Specialist, funded by the World Bank/IDA.

The main aims of the studies were to:

- evaluate traditional building materials and methods
- establish specifications and design guidelines for primary school furniture and facilities
- design, construct and evaluate prototype primary school buildings which could be built in the rural areas by local communities i.e. by self-help.

During this study period, prototypes of furniture and buildings were constructed using traditional and improved materials and village labour. This report is a summation of the findings of this research and puts the case for self-help as one method of increasing the number of classroom places available to primary school children in Sierra Leone.

Part 1 of the report gives general background information on physical, social and economic conditions in the country, and on the education system with special reference to primary education. It makes recommendations for future action to improve access to primary education, examines the possible role of self-help in a primary school construction programme and looks at how a construction programme could be managed.

Part 2 of the report illustrates designs for furniture, classrooms, classroom units, teachers' houses, pit latrines and site layouts for primary schools, and gives the background to the development of their design.

Part 3 first examines the building materials and methods available in the country and ways they might be improved. The second section takes the form of an illustrated construction handbook showing in a simple form the stages necessary to construct a typical classroom.

Most of the demographic and statistical information contained in the report comes from two sources, "The Population of Sierra Leone", and "Education and Development: Sector Study 1979" (see bibliography), updated with later material, particularly from the "Preliminary Report on the 1985 Population of Sierra Leone" where possible. Although the actual figures are therefore mainly out of date, the author believes that the basic situation in terms of population distribution and primary school enrolment, etc. has not changed greatly and that the underlying trends are the same. This will be seen more clearly when the complete results of the 1985 census are published.

A complete picture of primary education must await the completion of a comprehensive school mapping exercise as suggested in Part 1 of the report, but until this is carried out, it is hoped that this report will form a useful resource to be used by anyone working in the field of primary education in Sierra Leone.

It should be noted here that the views and opinions expressed in the report are those of the author and not of the Government of Sierra Leone or the World Bank/IDA. The author would however like to express his gratitude for the assistance given him by the staff of the Sierra Leone/IDA Education Project Unit, particularly the Project Director, the Deputy Project Director and the Project Architect.

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1. THE PHYSICAL, SOCIAL AND ECONOMIC BACKGROUND

A. BASIC DATA

Area	27925 Sq. Miles (71,740 Sq.Km)
Population (1985 Provisional)	3.7 million
Urban Population (Settlements over 2,000)	31.9%
Rural Population	68.1%
Rate of Population Growth (1974-1985	2.31% per annum
Life Expectancy at Birth (1983)	38 years
Infant Mortality Rate (1983)	201 per 1000 Live Births
Illiteracy Rate	85%
Primary School Population (5-14) (approximately 25% of total population)	925,000
Primary School 1987 Education Census	382,939
Gross Enrolment	41.4%
Female Pupils as Percentage of Total	44%
Number of Primary Schools	1,952
Pupil/Teacher Ratio : Average	32:1
GNP per Capita (1984) Estimates	US $310
Public Expenditure on Education (1983)	US $36.6 million
Public Expenditure on Education as Percentage of Total of Government Expenditure (1983)	17.6%
Public Expenditure on Education as Percentage of GNP (1983)	3.5%
Public Recurrent Expenditure per Primary Pupil (1983)	US $40
Exchange Rate (mid January 1989)	US $1 = Le 65

Table 1 : Basic Data : Compiled from various sources

B. GEOGRAPHY

LOCATION

Sierra Leone is a small compact country on the west coast of Africa, measuring some 215 miles from north to south and a similar distance from east to west. It adjoins the Republic of Guinea to the north and east and Liberia to the south-east, with the Atlantic coast to the south-west. It lies between latitude 6 55' and 10 north and longitudes 19 16' and 13 18'west.

VEGETATION

There is a diversity of vegetation types ranging from primary forest in the south and east, through secondary forest and farm bush, with mangrove swamps along the coast and Guinea savannah, inland swamps and grassland in the north.

COMMUNICATIONS

There are now in theory all-weather roads connecting the capital, Freetown, on the coast with the provincial towns, but they are usually badly in need of maintenance and, because of the pattern of small scattered settlements throughout the rest of the country, many of these latter are virtually inaccessible by road during the rains (fig.1).

PHYSICAL REGIONS

The country can be divided into four main physical regions (fig.2). The most extensive is the interior plateau and hill region to the north-east lying between 1,400 and 2,000 feet rising to 6,930 feet at its highest. This is separated from the interior plains by a scarp face that influences the distribution of rainfall, vegetation and roads and is a marked physical, human and economic divide. The plains themselves range in height from 100 to 750 feet with occasional hills rising above 1,000 feet. The third region, the coastal plain, lies mostly a few feet above sea level and varies in width from 5 to 25 miles. Rising above this coastal plain to nearly 3,000 feet is the fourth region, the Western Peninsula mountains, stretching south some 25 miles from the capital Freetown.

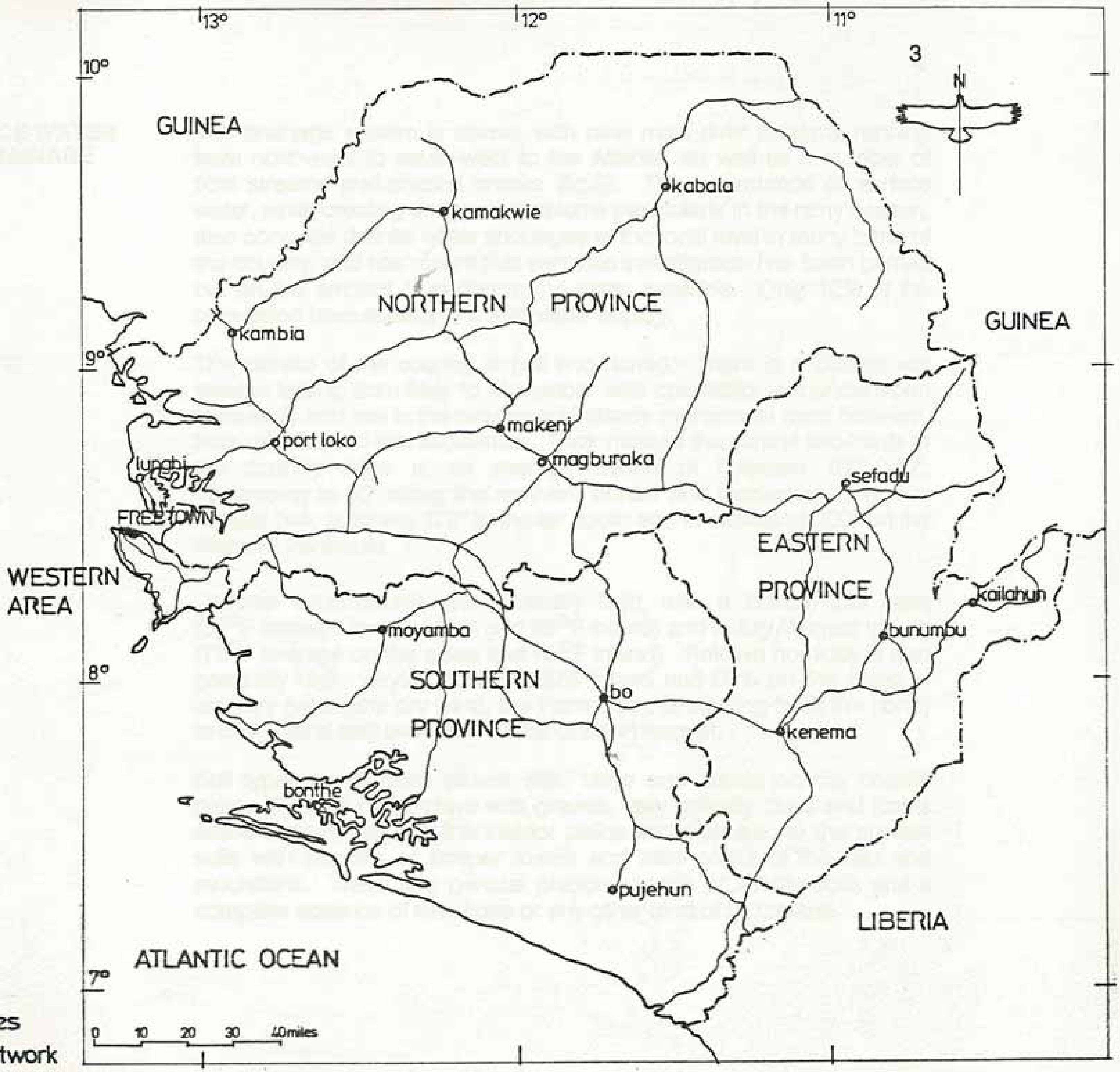


fig.1 provincial boundaries
main towns and road network

SURFACE WATER AND DRAINAGE

The drainage system is dense, with nine main river systems running from north-east to south-west to the Atlantic, as well as a number of tidal streams and coastal creeks (fig.2). This abundance of surface water, while creating transport problems particularly in the rainy season, also conceals definite water shortages at the local level in many parts of the country, and has meant that very little investigation has been carried out on the amount of underground water available. Only 12% of the population have access to a safe water supply.

CLIMATE

The climate of the country is hot and humid. There is a distinct wet season lasting from May to November with convectional thunderstorm rains early and late in the season and steady monsoonal rains between, from mid-June to late September. Over most of the central two-thirds of the country there is an average rainfall of between 100"/120", decreasing to 80" along the northern border and increasing along the coastal belt, reaching 170" in the far south and in excess of 200" on the Western Peninsula.

Daytime temperatures are generally high, with a March/April crest (88°F average on the coast and 96°F inland) and a July/August trough (72°F average on the coast and 60°F inland). Relative humidity is also generally high, varying from 40/50% inland and 60% on the coast in January (when the dry wind, the Harmattan, is blowing from the north) to 80% inland and over 90% on the coast in August.

SOILS

Soil types range from alluvial silts, clays and sands on the coastal plains, through clays, clays with gravels, very gravelly clays and loams and the sandy clays of the interior plains and plateaux, to the shallow soils with pockets of deeper loams and bare rocks of the hills and mountains. There is a general preponderance of laterite soils and a complete absence of limestone or any other kind of pozzolana.

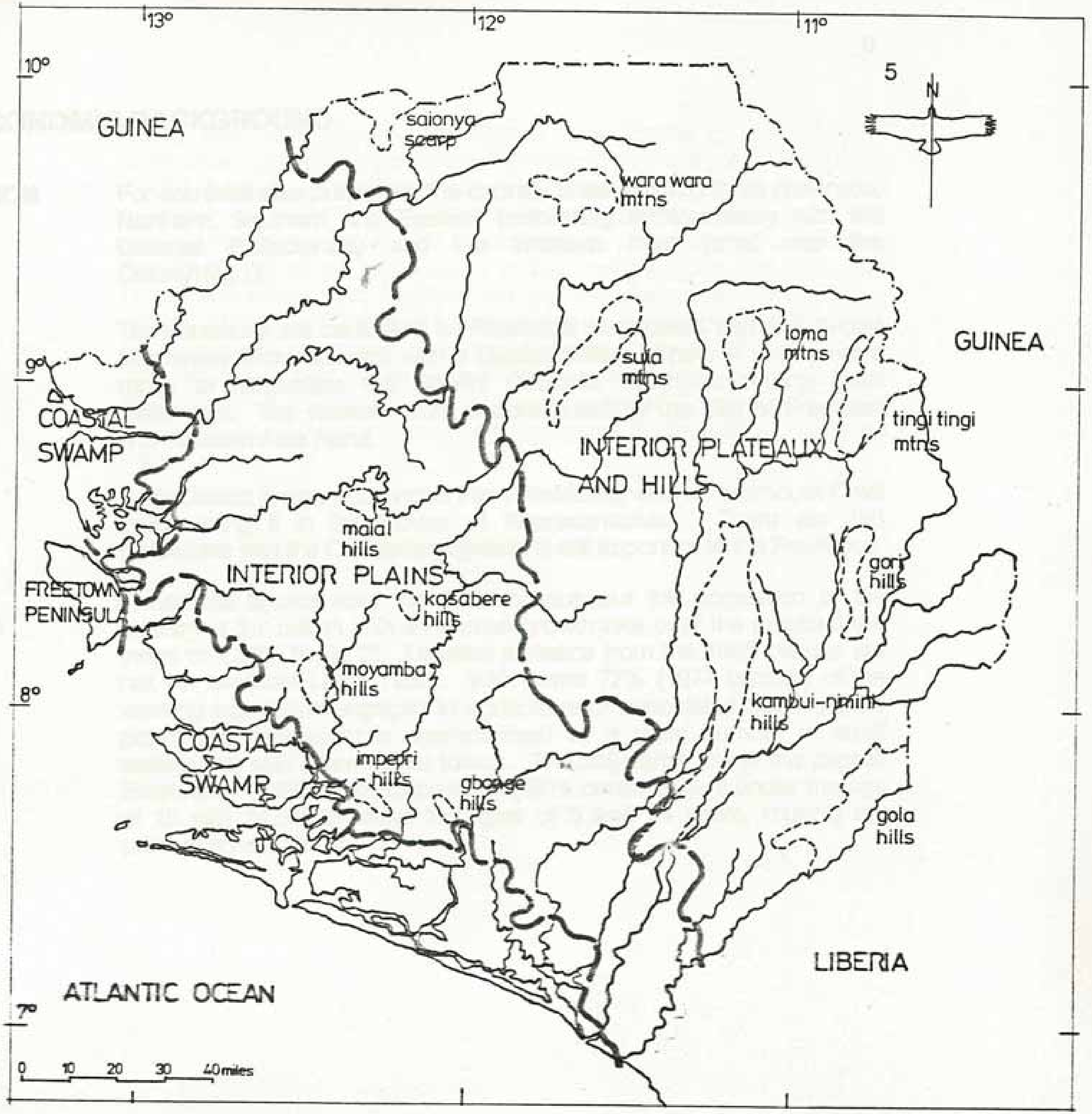


fig.2 physical regions and main drainage pattern

C. SOCIO-ECONOMIC BACKGROUND

ADMINISTRATION

For administrative purposes, the country is divided into three provinces, Northern, Southern and Eastern (coinciding approximately with the Colonial Protectorate) and the Western Area (what was the Colony)(fig.1).

The provinces are controlled by Provincial Secretaries and are divided into twelve Districts, each with a District Officer. There is at present a move to resuscitate the District Councils which have long been disbanded. The Western Area is constituted by the City of Freetown and Western Area Rural.

Each District is also subdivided into Chiefdoms, with a Paramount Chief representing it in the House of Representatives. There are 146 Chiefdoms and the Chieftaincy system is still important in the Provinces.

POPULATION DISTRIBUTION

Provisional figures from the 1985 census put the population of the country at 3.7 million with an annual growth rate over the previous ten years of 2.31% (table 2). Detailed statistics from the 1985 census are not yet available (June 1989). With some 72% (1974 census) of the working population engaged in agriculture or associated activities, the population distribution is characterised by a great number of small settlements with a few larger towns. The only large city is the capital, Freetown. 40.5% of the population (1974 census) were under the age of 15 with 24.5% between the ages of 5 and 14 years, roughly the primary school years.

Using the 1974 figures, an attempt was made to estimate the rural/urban characteristics of the population. An analysis showed that 72.4% lived in settlements with less than 2,000; and that while approximately 66.3% of all settlements had no more than 100 inhabitants, they contained 17.2% of the total population. Furthermore that 96.4% of all the settlements in the country have less than 500 inhabitants and contain 55.3% of the total population, with 15% living in villages of between 500 and 2,000 people. A similar breakdown of the 1985 census figures is not yet available but the percentage of the population living in settlements of 20,000 people has gone up from 16.4% in 1974 to 20.2% in 1985. It can be stated however that Sierra Leone still has a predominantly rural population living in small, scattered settlements.

District	1985 Pop.	% Change 74-85	Av.Ann. % Growth 74-85	% Dist. of pop 85	Pop Density 85*	% Urban 85	Male 85	Female 85
Bo	268,671	23.4	1.93	7.6	133	30.4	132,131	136,540
Bonthe	105,007	19.9	1.67	3.0	78	16.3	51,611	53,396
Bonthe Rural	97,975	21.5	1.79	2.8	73	10.2	48,122	49,853
Sherbro Urban	7,032	1.1	0.10	0.2	1,758	100.00	3,489	3,543
Moyamba	250,514	32.7	2.61	7.1	94	9.1	121,213	129,301
Pujehun	117,185	14.1	1.20	3.3	74	7.3	56,174	61,011
Kailahun	233,839	29.6	2.39	6.7	157	25.8	114,318	119,521
Kenema	337,055	26.4	2.15	9.6	144	29.7	172,084	164,971
Kono	389,657	18.5	1.55	11.1	179	38.1	205,670	183,987
Bombali	317,729	35.2	2.78	9.0	103	17.4	151,920	165,809
Kambia	186,231	19.9	1.66	5.3	155	18.8	88,887	97,344
Koinadugu	182,283	15.6	1.32	5.2	39	11.6	87,587	95,699
Port Loko	329,344	12.7	1.09	9.4	149	14.6	158,035	171,309
Tonkolili	243,051	17.8	1.02	6.9	90	13.2	119,191	123,860
Western Area	554,243	75.2	5.23	15.8	2,578	88.4	287,234	267,009
Freetown	469,776	70.1	4.95	13.4	93,955	100.00	243,526	226,250
Western Area Rural	84,467	100.8	7.02	2.4	402	23.4	43,708	40,759
Sierra Leone	3,515,812[1]	28.5	2.31	100.00	127	31.9	1,746,055	1,769,757

* per square mile

[1] Adjusted up to 3,700,000

Table 2 : Population Distribution 1985 Census Figures

ADULT LITERACY

Despite recent attempts to increase the rate of adult literacy, it is estimated that 85% of the adult population is still illiterate, rising possibly to 98% in the rural areas.

THE ECONOMY

Per capita GNP was estimated at US $280 in 1982 and US $310 in 1984, with significant disparities between the urban areas (US $700) and the rural areas (US $150). Even within the urban areas, however, about 25% of the population had an income level below the urban relative poverty level, estimated at US $198 per annum.

The agricultural and mining sectors have been the main sources of income, with the agricultural sector, primarily subsistence farming, providing a livelihood for nearly 65% of the population, although producing only 30% of GNP.

Production of diamonds, while still accounting for 37% of the country's export earnings in 1981-82, is steadily declining. The country's former second largest foreign exchange earner, an iron ore mine, closed in 1975. Mining production as a whole declined by about 60% over the same period. Agricultural exports did increase in volume and value at that time. However, worldwide low commodity prices are now adversely affecting this increase.

The current account balance which showed a deficit of Le.18 million in 1970-71 registered a deficit of Le.184 million by 1980-81. Poor economic performance led Sierra Leone to seek IMF assistance in 1979 and 1980, but the Extended Fund Facility Agreement was suspended by the IMF in June 1981. Negotiations still continue with the IMF over further loans and measures have been taken to comply with IMF conditions such as successive devaluations of the Leone and the doubling of fuel prices (July 1989)

2. EDUCATIONAL BACKGROUND WITH SPECIAL REFERENCE TO PRIMARY EDUCATION

A. THE EDUCATION SYSTEM

ADMINISTRATION

The entire education system, including the University, comes under the Ministry of Education, Cultural Affairs and Sports.

The Ministry of Education Cultural Affairs and Sports is headed by a Minister and administered centrally from Freetown. The professional head is the Chief Education Officer, assisted by a Deputy Chief Education Officer (General), a Deputy Chief Education Officer (Planning) and an Assistant Chief Education Officer. The Primary Division is headed by the Principal Education Officer (Primary). As a move to decentralisation, Regional Principal Education Officers have been appointed to head the Ministry's Offices in the three Provinces, but in reality all decisions are still made centrally. There are Inspectors of Schools (Primary) in each district who, with supporting staff, supervise and administer primary education.

The administration of the primary and secondary systems is largely carried out in co-operation with employing authorities, composed of religious organisations, municipal and local authorities and other private groups. This is a legacy from the past when schools were owned and run by these bodies. At the primary level the day-to-day running of schools is delegated by the Ministry to these employing authorities. The Ministry does now run, through the Inspectors of Schools, the primary schools (D.E.C. Schools) previously run by the District Councils which were disbanded in 1972.

ORGANISATION

The formal education system now consists of a six year primary cycle starting at the age of 6, a five to seven year general secondary cycle and a three to five year University Programme. Within the system there are a number of specialised programmes.

The primary cycle was, prior to 1984/85, a seven year one starting at age 5 but this was changed in the school year 1984/85 when all pupils entering should have been aged 6 or over, the cycle becoming a six year one. The six and seven year cycles will run concurrently until June 1990 when the last pupils who entered at age 5 should complete their primary schooling.

There does, however, seem to have been considerable confusion in many schools over this change and it is suspected that some children are still entering below the age of 6. Accurate recording of birth dates in the rural areas can be difficult.

The primary school year consists of three terms, five days a week, running from September to July. It thus starts and ends in the rainy season. The school year has approximately two hundred teaching days. Some schools, mainly in the towns, operate a double-shift system. In this system, two separate "schools" each with its own head teacher, teachers and pupils, operate in the same buildings, one in the morning and one in the afternoon.

B. PRIMARY EDUCATION

AIMS OF PRIMARY EDUCATION

According to the 1969 primary syllabus the goal of primary education is "to provide full opportunity for acquiring knowledge and skills essential for each stage of the child's development as a basis for living and as a foundation for further education".

The aims of primary education as described in the 1976 Education Review were stated as:

a) Literacy in one or more languages, eventually to include literacy in at least one Sierra Leonean language and in the official language, English.

b) Numeracy.

c) A rational approach to natural and social events through observing and understanding the environment in which the students live.

d) Occupational skills at an elementary level.

e) Positive attitudes towards themselves and their cultural background, towards work and the process of community and national development.

f) Positive traits of character and ethical values.

Thus very little cognisance has been taken of the fact that for a large percentage of the primary school population their education at primary school will be their only education. Only a very small percentage of primary schools have established any sort of agricultural programme.

The Bunumbu Project has to some degree taken this into consideration and is developing a more rural-orientated, practical-skills-based curriculum (see over).

TYPES OF SCHOOLS

There are four types of Primary Schools:

a) Assisted Schools: run by employing authorities on behalf of government, who provides, or should provide, a capitation grant for running costs, books and other materials and for development and in addition pays teachers' salaries.[1] Tuition fees are regulated by government. In 1977/78, 96% of schools in the country were of this type.

b) Local Government Schools: In Freetown some Primary Schools are run by the Freetown City Council. In the Provinces, what were the District Education Committe Schools run by the District Councils have, since the disbanding of the Councils, been run by the District Primary School Inspectorate.

c) Independent Schools: owned and run without the control of Government but maintaining minimum standards as required by the Ministry. There are a very small number of these. Standards are generally high, as are the tuition fees.

d) Private Schools: receive no government grants and the quality of teaching and facilities is poor, sometimes not up to the minimum required by government, and fees are not controlled although they are usually less than for Independent Schools. Again there are only a small number of these.

1.For the 1986/87 school year, Government gave one employing authority in a Northern District LE.3,000 as the capitation grant. This authority actually spent in that year Le.260,000 on maintaining and improving buildings, providing chalk and exercise books, desks and chairs and some pit latrines, not including new school buildings. Obviously not all employing authorities can afford this level of support and supervision but presumably they should be attempting to do so.

TEACHERS AND TEACHER TRAINING

In 1977/78 there were 7,088 teachers in 1,118 primary schools in the country. Of these, 1,793 or 25.3% were female, but only 2,777 or 30.2% were fully qualified. The great majority were Sierra Leoneans with a few foreign teachers, mainly volunteers. The overall pupil/teacher ratio in 1977/78 at 32:1 was the same as in 1970/71, but the pupil/qualified teacher ratio was 82:1. It should be noted that while one objective in the 1970 Government White Paper was to reduce the pupil/teacher ratio from 5:1 to 35:1, this policy has now been reversed and, in order to reduce recurrent costs, a pupil/teacher ratio of 45:1 by the school year 1990/91 is now the Ministry's objective (see below).

There are five Primary Teacher Training Colleges. Of these, one in Freetown was established as an in-service training institution for up-grading primary schools teachers already in service. A new campus is presently being built for the College just outside Freetown but work on this is currently (mid 1989) at a standstill.

At Bunumbu Teachers College, in Eastern Province, a UNESCO/UNDP Project has since 1974 been developing programmes for training multi-faceted primary school teachers to serve rural communities, and also a curriculum more suited to all primary schools. This programme is now being extended to all the Teachers' Colleges. At Bo Teachers College, new facilities are being provided and ten pilot primary schools extended, all funded by UNDP/UNCDF.

The findings of the Education Census of 1987 which provide the most up-to-date figures on numbers of teachers can be summarised as follows:

The number of full-time primary school teachers was 11,820 of whom 60% were unqualified. The national pupil/teacher ratio was 32.4:1. By this time, if the Ministry's objective of 45:1 by 1990/91 was to be attained it should have been 42:1.

However, one should note that the ratio of pupils to qualified staff was still 81:1; that is only slightly better than in 1977/78. One should also note that, as pointed out in the census, some schools in Freetown and the large provincial towns employ part-time teachers who do not appear in the statistics.

The situation therefore seems to be that while qualified primary school teachers are being produced by the Teacher Training Colleges at a rate of about 680 a year, the majority of these are not entering the teaching profession, certainly not in the rural areas. This is presumably due to a variety of reasons, the chief ones being: the low pay scales for primary school teachers; late payment of salaries; the lack of teachers houses in most villages; and the high cost of transport and lack of services and other facilities in the rural areas. Some teachers houses are being built in the rural areas under the third Sierra Leone/IDA Education Project but again this Project is currently at a standstill.

C. ACCESS TO PRIMARY EDUCATION

PRIMARY ENROLMENT

While from 1968 to 1977/78 primary enrolment was almost equally shared between the four provinces, there were wide regional disparities in the growth rates in the provinces, with the highest rate in Northern Province and the lowest rate in Western Area. There were similar disparities in the proportion of girls enrolled in 1968/69, the highest proportion being in Western Area and the lowest in Northern Province. During this period, while the recommended age range for primary school children was 5-12, the actual range was 5-15.

Using this latter enrolment range, by 1977/78 only 31.7% of those of school age were actually enrolled and there were wide differentials in the enrolment between different sizes of settlements. Thus in Freetown the figure was 61.5%: in towns of between 5,000/20,000 people the figure was 75.5%: but in villages below 2,000 the figure was only 21.2%. The sex differential between different sizes of settlements was clearly marked. In towns of 5,000/20,000 the figure was 92.2% for boys and 60.3% for girls; in villages of 2,000 and below, the figure was 26.2% for boys and 15.5% for girls. Enrolment ratios also varied widely between the provinces with the highest (61.7%) in Northern Province.

The gross enrolment figures taken from the 1987 Education Census show that whereas enrolment in the South and East has remained fairly steady at 21.3% and 26.81%, that for the North has again increased (31.13%) and Western Area dropped (20.68%). There is unfortunately no breakdown yet by sex or settlement size.

Gross enrolment has increased from 139,412 in 1968/69, 227,815 in 1977/78 (63.4% up) to 382,939 by 1987 (68% up). As the government was aiming at a gross enrolment ratio in 1984/85 of 66.2% for the 5-11 year old population, the actual ratio of 44.4% is very low, 17.7% below the projected enrolment for the year presented in the 1979 Sector Study. Government does not therefore seem to be meeting its programmed objectives for 100% primary enrolment. Some 500 primary school classrooms were to be built in the rural areas under the third Sierra Leone/IDA Education Project but the first phase of 250 classrooms is to date (mid 1989) still unfinished.

It should be noted here however that the Planning Division of the Ministry of Education, Cultural Affairs and Sport's estimates for gross enrolment in 1985/86 were 421,689 or 66% of the primary school population. The discrepancies between these various figures might be resolved when the complete 1985 census figures are available, but the Ministry's figures do at present seem over-optimistic.

REASONS FOR LOW ENROLMENT

A number of reasons have been advanced for the low enrolment ratio in the country as a whole and particularly among girls.

These include:

a) Traditional beliefs and religion. Women are traditionally, legally and economically dependent on the husband and girls play an active role in the family from an early age both in the home and on the farm. Islam also has had a negative effect on the enrolment of women and this is particularly noticeable in Northern Province and in the smaller settlements in the country where Islam is strongest.

b) The cost of education is a disincentive to a greater enrolment rate. Although school fees for classes 3-7 have officially been abolished, there is some evidence to suggest that fees are still being charged unofficially. School fees were (or are) however a small proportion of the actual cost of primary schooling which includes the cost of textbooks, exercise books, pens, pencils, school uniforms etc. The cost of all of these has risen greatly in the last few years, especially in the smaller settlements where these materials are anyhow largely unobtainable. Cash to pay for these items is not easily available to farmers in the remote areas. All these factors, together with women's traditionally low status makes the cost of sending boys to school rather than girls seem a better investment.

c) The scattered pattern of small settlements must also affect the enrolment ratio, with approximately 72.4% of the population living in villages with less than 2,000 persons and 17.2% of the settlements containing less than 100 persons. Many communities are too small to support full schools and are too far from full schools for small children to be able to walk to them.

FEEDER SCHOOLS

There has therefore been a tendency for feeder schools to be set up in small villages, operating classes one to three with children transferring to the parent school at class four. According to the 1987 education survey there is a total of 1,952 primary schools in the country of which 717 (36.7%) are recognized feeder schools, with undoubtedly many more unrecognized ones.

These feeder schools tend to have small classes with few teachers (usually the lowest qualified and most inexperienced) and inadequate facilities. Therefore they have to operate multi-class teaching with untrained teachers. All these factors mean that pupils learn very little, parents lose interest and children are withdrawn. The settlement pattern therefore seems to be one of the main barriers to any increase in access to education.

SETTLEMENT PATTERN

Using the 1974 census data, the smallest settlement that will support a full six class school with a pupil/teacher ratio of 1:45 would contain 1,080 persons, assuming that the school age population 5-15 constituted 25% of the population. However this would only be possible if there was 100% enrolment. If a more realistic estimate of 50% enrolment was used, the settlement would have to be around 2,000 persons. Since it was estimated then (1974) that 98.7% of all settlements contained less than 1,000 persons only a small fraction of settlements are capable of supporting a full school with one teacher for each class. Note that 63% of the population are still living in settlements of less than 1,000 people (1985 census).

These figures suggest that the feeder school system is necessary to provide class 1-3 schools in small settlements and that teachers must be trained in multi-class and team teaching in order to be able to teach adequately.

Although the settlement pattern is changing slowly it is estimated that by the year 2,000, 45.9% of the population will still be living in settlements of less than 2,000 people. Thus if enrolment ratio is increased to 50% or more, a great number of two classroom and three classroom schools will still have to be built in the smaller villages with less than 1,000 people. A two classroom unit seating 88 pupils in two rooms would serve a settlement of 700 with an enrolment ratio of 50%; a three classroom unit seating 132 would serve a settlement of 1,050 with an enrolment ratio of 50%.

LACK OF QUALIFIED TEACHERS

As indicated above, the lack of qualified and experienced teachers is another obstacle to the expansion of primary education. Approximately 40% of all teachers are qualified and 45% of all teachers have taught for less than five years; of these latter, only 22% are qualified. Thus an increasing proportion of new teachers are unqualified.

The qualified, experienced teachers of course tend to concentrate in the towns (over 2,000 population) where there are more facilities, more opportunities for promotion etc., with the schools in the smaller settlements having the less qualified, less experienced teachers. But as pointed out above, these smaller schools with small classes are the ones that need experienced teachers able to carry out multi-class teaching. One way of attracting better qualified teachers to villages would be to provide teachers' housing, as accommodation for teachers in any size of settlement is always a problem.

Another way that has been suggested would be to give some teachers the added responsibility of (and extra pay for) managing a group of feeder schools. This would provide the opportunity for advancement and help co-ordinate the activities of the schools.

SCHOOL BUILDING STOCK

The existing stock of primary schools range from rented village houses to fairly modern concrete block buildings with steel windows, the latter mainly in Freetown and the larger Provincial towns.

The bulk of rural primary schools are built of mud blocks, or of mud plaster on a bush-stick framework with corrugated iron roofs. Some have timber shutters as windows but many are completely open. Some now being built under 'Aid' projects are constructed of stabilised-soil blocks usually made with a Cinva-ram machine.

Classroom sizes are generally small, a common size being 20'0" x 22'0". Furniture, if it exists at all, usually consists of narrow benches and tables. In many schools children bring their own chairs (sometimes desks as well) or sit on the floor.

A large percentage of schools are in a very bad state of repair though some religious organisations do spend some money on maintenance. The Ministry of Education has very little money to spend on buildings. In 1983/84 it spent Le.7,040 on the rehabilitation of primary school premises; in 1984/85 the figure was Le.143,000 and in 1985/86 it was anticipated that Le.229,200 would be spent.

It seems that no new government primary schools are being built apart from the 500 classrooms and 66 staff houses at present being constructed in two phases under the third Sierra Leone/IDA Education Project. This Project is however presently (mid 1989) at a standstill. Some religious organisations are continuing to put up new school buildings. Although these have in theory to be approved by the Ministry, this usually only entails approval by the District Inspector of Schools (Primary) and there is little or no technical monitoring of school buildings.

TEXTBOOKS, EXERCISE BOOKS AND OTHER TEACHING MATERIALS

The availability of textbooks and other teaching aids in the primary school system has been generally very low, particularly in the rural areas. This is both because an efficient distribution system does not exist and because government does not have funds to purchase and supply these items.

As noted previously the supply of exercise books and pens, which have to be purchased by the pupils, is also limited, particularly in the rural areas where prices are also much higher. Under the Sierra Leone/IDA Third Education Project approximately one million textbooks and 125,000 teachers' guides in English, Mathematics, Science and Social Studies for classes one to six are being distributed. However there will not be enough to supply all schools in the country.

D. QUALITY OF EDUCATION

Although the gross pupil/teacher ratios are low at the primary level, the ratio of qualified teacher to pupils is very high and this, together with the lack of textbooks and other learning materials, overcrowding and the poor repair of buildings, is having a detrimental effect of the quality of education.

The poor quality of the teaching environment has had a negative impact on the internal efficiency of the system and about 35% of primary school students drop out before reaching the end of class seven and about 12% of pupils in each class are repeaters. Much of the drop out occurs in the lower classes and the rate of drop out is higher in the rural areas. The drop out rate for girls is also higher than that for boys.

Available evidence also suggests that student achievement is low, with only about 55% of primary school children passing the Selective Entrance Examination for secondary schools each year and with pass rates of about 20% at 'O' level. The quality of education therefore does not seem to be improving.

3. IMPROVING ACCESS TO PRIMARY EDUCATION

A. RECOMMENDATIONS

IMPROVING ACCESS Given the economic state of the country and the financial constraints faced by government, the main problem now to be addressed is how to improve access to primary education, particularly to children in the rural areas, without unduly burdening the government's capital expenditure and recurrent budgets.

IMPROVING THE LITERACY RATE Sierra Leone is, and will remain for this century and well into the next, a predominantly agricultural country, and therefore probably the most important contribution primary education can make is to ensure that the coming generation of farmers are literate and numerate enough to promote significant increases in agricultural production. Studies have shown that literate adults adopt improved agricultural practices more readily. Thus for the government's investment in agriculture and rural development to produce a reasonable return, there must be a rapid increase in the literacy rate.

A MORE RELEVANT CURRICULUM Given that for a large proportion of pupils this will be their only education, the primary school curriculum must be made more relevant to the needs of everyday life in the village and have a more vocational and agricultural bias.

COMMUNITY CENTRES Primary schools must come to be seen not simply as schools for young children but more as multi-purpose centres of the community, teaching literacy and numeracy to adults, health education, development studies etc.

CONSTRUCTION OF CLASSROOMS

Given the low enrolment rates in the rural areas, there is a need to increase the numbers of primary school places available, particularly in the smaller settlements, by the construction of more classrooms. However, it has been shown that the construction of high quality buildings does not in itself improve the quality of education and thus the money spent on building should be minimised. Some money must be spent however on the maintenance of existing buildings in order to obtain the maximum benefits from them. One effect of low standard, poorly maintained buildings must be to discourage pupil attendance.

LOWERING THE COSTS

In order to help increase the enrolment ratios, the actual cost of primary education to parents must be reduced as much as possible by lowering the cost of books, pens, pencils, improving their distribution in the rural areas, and possibly by abandoning school uniforms. The former would have an additional beneficial effect as the provision of textbooks and instructional materials is now seen as one of the best ways of improving educational quality.

IMPROVING TEACHING QUALITY

The quality of teaching in the rural areas must be improved by increasing the skills of teachers, particularly those of the large numbers of unqualified teachers, by in-service training. This training should emphasise in particular skills such as multi-class and team teaching.

In order to attract better trained teachers to the rural areas and keep them there, their conditions of service must if possible be improved. Given the economic situation, large salary increases will no doubt be impossible, but if housing can be provided (possibly built by the community by self-help) and more responsibility given to well qualified teachers by reorganising the management of small rural schools, this will undoubtedly help. Regular payment of salaries will also no doubt help. The primary school teacher must again become an important person in the rural community.

STRENGTHENING THE INSPECTORATE

The District Inspectorate must be strengthened and supported. Transport should be provided so that rural teachers are not isolated and their morale is kept high. This will also have the additional benefit of keeping a continuous check on the running of the primary school system.

IMPROVING PRIMARY HEALTH CARE

Lastly, the health of primary school children must be improved through primary health care, school feeding programmes etc. in order that children can extract the maximum benefit from their education. The government is at present, with the assistance of WHO, UNICEF and other Agencies, extending and strengthening its primary health care programme, its under-5 immunisation programme and its programme to provide clean drinking water to villages in the rural areas. It must be recognised, however, that if these programmes are effective there will no doubt be an increase in the birth rate and a commensurate increase in the number of primary school age children in the next decade and thus a need for yet more primary school places. As has been clearly shown elsewhere, the only real way to contain a rising birth rate is through the education of the population in general.

DOUBLE-SHIFT SCHOOLS

It should probably be noted here that in some sub-Saharan African Countries, a system of double-shifts for primary schools has been tried as a way of reducing the capital and running costs of schools. This has also been tried sporadically in Sierra Leone but in the hot, humid climate it must be stated that children in the afternoon shift are at a definite disadvantage and this cannot really be seen as a solution to the problem of access.

B. PRIMARY SCHOOL CONSTRUCTION AND THE ROLE OF SELF-HELP

BUILDING COSTS

The cost of school building is now a substantial fraction of the total cost of providing primary education and therefore in order to construct as many primary school classrooms as possible at the lowest possible cost, locally available, low cost materials must be used for buildings and furniture.

These materials must be used in such a way that the buildings are sound, have low maintenance costs and a reasonably long life.

THE ROLE OF SELF-HELP

Because of economic constraints, the responsibility for primary school construction and maintenance must increasingly be transferred from central government to local communities. One effect of this should be to ensure that new schools are opened where the demand for primary education is greatest and where parents are prepared to contribute most.

The goodwill of rural communities, undoubtedly anxious that their children receive the best possible education, will have to be utilised in assisting both with the provision of materials such as sand, stone, boards and bush-poles and with the construction of buildings, including, if possible, staff houses.[1]

1. This may seem unfair to the rural population given the fact that the urban populations have a stock of primary schools already built to a fairly high standard, but it should be realised that nearly all these buildings now need maintenance works or upgrading and that parents will have to be mobilized to effect these works. Any new buildings needed in the urban areas will also, no doubt, have to be carried out on a self-help basis if external assistance is not forthcoming.

SIMPLICITY OF DESIGN

The design of buildings must therefore be simple. They should be easy to construct with the materials available and yet deal with the extremes of climate found in the country, especially the heat, humidity and heavy rain. Any design for primary schools should ideally be able to provide a range of sizes of classroom, workshop and other spaces and be able to cope with multi-grade teaching wihin one classroom.

ORGANISATION OF SELF-HELP

A building programme which relies to any extent on self-help must be well organised and technically assisted or it will fail. Village people cannot be expected to be, or become overnight, skilled builders. Community organisation and technical support and assistance, probably on a day to day level, will be required as well as, most importantly, transport for materials and supervisors.

Self-help programmes also require time, given the fact that villagers will most probably be farmers and will have to fit in building work with their farming seasons. Most work will have to be undertaken therefore in the dry season.

ASSISTANCE TO COMMUNITIES

Some form of reimbursement should also be considered for communities building their own schools, either in the form of "Food for Work"; help with materials for building the school; with equipment for the school when completed; or possibly with cash payments for a proportion of the work done. Rural communities are largely outside the cash economy and it is surely too much to expect them to totally fund their schools as well as build them.

Most importantly it must be remembered that a great number of these schools will be built in very remote locations with all the extra problems that this will cause for transport, supervision, support etc.

THE COMMUNITY'S ROLE

Before embarking on any self-help programme, the Community must be made to understand its role and responsibilities in the project and most importantly that a "proper" school can be built using self-help and low cost locally available materials. The self-help approach should help to build self-reliance in the community and a successful project should teach people to face and analyse their problems and initiate other projects to solve communal problems.

A successful, well run and technically assisted programme would also serve as a training programme for the community, improving the technical skills of local masons and carpenters, training young people in technical skills and improving the ability of the community in general to run similar projects in the future. It could also be used to train local technicians, architects, engineers etc. in the design and supervision skills necessary in such a programme.

C. CO-ORDINATION OF A PRIMARY SCHOOL CONSTRUCTION PROGRAMME

AN EDUCATION FACILITIES UNIT

Any proposed primary school building programme, however it is undertaken, should be co-ordinated by the Ministry of Education either through the existing Building Inspectorate within the Planning Unit or through a separately established Education Facilities Unit. This Unit should be able to direct and co-ordinate a programme of maintenance and extension of existing primary schools and the construction of new ones.

Besides having the technical expertise to carry out these tasks, it must also have the operational capacity and necessary authority. Thus it will require vehicles, equipment and funds to meet running costs, together with the full support of the Ministry.

SCHOOL MAPPING

The first priority for such a Unit should be to carry out a comprehensive primary school mapping exercise in order to establish the exact location and type (whether parent or feeder) of each school, its number of pupils, teachers and classes, the number, type and physical condition of its buildings, its religious denomination, whether there are any teachers houses, water wells, latrines etc.

This countrywide school map could be used, together with the final population figures and projections from the 1985 census, to establish the actual need for new primary school classrooms and their locations. A building programme could then be prepared for the maintenance, repair and extension of existing schools and the building of new schools.

DESIGN STANDARDS

The Unit's second priority should be to establish standards for the construction of classrooms, staff houses, pit latrines, etc. in the form of guidelines, space standards, classrooms and furniture design. Part 2 of this Report provides a starting point for this exercise.

IMPLEMENTATION

Its third priority should be to study realistic ways of implementing such a building programme whether through the use of contractors, large or small, 'self-help', the Ministry of Works or whatever.

The Unit should co-ordinate these activities with the other Ministries or Departments that would be involved in a building programme such as Development, Social Welfare, Works, Health, Energy and Power etc.

With a properly planned and phased programme of maintenance and construction, the Unit could then approach Aid Agencies, Volunteer Organisations etc. for assistance in implementing a programme, through direct funding, technical assistance, 'Food for Work' etc. Funds are available for construction work, furniture and equipment and there is interest in assisting with the supervision and training of artisans, supervisors etc. for such work but a well worked out programme must come first.

The building programme and guidelines established by the Unit will have to be flexible enough to accommodate the different agencies that could be involved and the different materials and methods of building likely to be used, whether they are the use of contractors, self-help etc.

SELF-HELP

Given all the constraints and opportunities outlined elsewhere in this report, self-help could obviously play a large part in a primary school building programme. However "self-help" can only really play a part within a long term rolling programme of construction and maintenance. Self-help projects, for reasons outlined above, tend to take a long time and must be supported, supervised and monitored over a long period. Various ways of using the self-help methods are discussed below.

D. POSSIBLE MODELS FOR A PRIMARY SCHOOL SELF-HELP BUILDING PROGRAMME

ORGANISATIONAL MODELS

There are a number of ways a self-help programme could be organised, some of which have already been tried in Sierra Leone and elsewhere.

BO-PUJEHUN RURAL DEVELOPMENT PROJECT

In the Bo-Pujehun Rural Development Project, operating in Bo and Pujehun Districts in Southern Province, communities are encouraged to request assistance in constructing classroom units for extending existing primary schools. This request then has to be justified by the community and a percentage of the cost raised in cash. A site has to be provided, together with local materials such as sand, stone and timber and a guarantee given to supply labour and pay any necessary craftsmen. The NGO will then supply and deliver the necessary imported materials such as cement and roof sheets.

These Projects are at present usually supervised by a social worker on a weekly or monthly basis and suffer from a lack of trained, technical supervision which inevitably leads to poor quality buildings. They also suffer from lack of transport facilities for locally provided materials which greatly slows up progress. A large responsibility is placed on the community to provide materials and labour and actual money. The Foster Parents Plan International Project operating in Bombali District and Western Area rural is building primary schools in a similar manner.

SIERRA LEONE SELF-HELP RURAL WORKS PROGRAMME

In the Sierra Leone Self-Help Rural Works Programme, through which roads, health centres and primary schools have been built, all materials are supplied and the only local input is unskilled labour which is paid a small amount in cash and 'food for work' provided by the World Food Programme. Skilled labour is provided by the Ministry of Works. Technical supervision is provided on a daily basis by United Nations Volunteers assisted by Ministry of Works junior engineers. Each project has vehicles for material deliveries, supervision etc. The community development aspect does however seem to be lacking, although this is now being stressed to a greater extent.

CARE : LIBERIA/ WORLD BANK PRIMARY SCHOOL PROJECT

In the CARE:Liberia/World Bank Primary School Project the construction of schools was carried out by CARE with self-help inputs from local communities and with imported materials funded by the World Bank. The community was required to provide, clear and level the site, construct access roads and provide labour for loading sand and stone and for excavating trenches etc. This community work was recorded and priced by CARE and on completion of the building, teaching materials and books of an equivalent value were provided to the school.

UNICEF : NEPAL PRIMARY SCHOOL PROJECT

In the 1970's in Nepal the UNICEF Primary School Project recognised that while rural communities can be made responsible for the construction and maintenance of school buildings they must be provided with incentives, either in the form of cash or materials, in order that a high standard of work is carried out. Thus a series of payments were made on the basis of the successful completion of each stage. There was also, most importantly, continuous supervision of construction by qualified technicians. This model is now also being tried out in the Republic of Guinea.

BUNUMBU TEACHERS COLLEGE PILOT PRIMARY SCHOOL PROJECT

At Bunumbu Teachers College in the 1970's, the self-help programme to build 20 pilot primary schools financed by UNDP was based at the College and managed by Catholic Relief Services with technical supervision carried out by Peace Corps and VSO volunteers. Community development work was carried out by the College's Department of Community Development. Materials such as sand and stone were provided by the local communities. The Project was very centralised with most building components being produced by a technical team at Bunumbu Teachers College and with very little local technical input or training.

BO TEACHERS COLLEGE PILOT PRIMARY SCHOOL PROJECT

The Bunumbu Project is now being replicated at Bo Teachers College where ten existing pilot primary schools within a 20 mile radius of the College are being extended, classrooms, wells and pit latrines built, roads improved and furniture provided.

The organisation of the Project is different to the earlier phase at Bunumbu. A Project Execution Unit has been established at Bo Teachers College which supervises and co-ordinates the construction work. Local materials are provided by the communities together with labour. Voluntary labour is recompensed with 'food for work'. Labourers and artisans working full time on the Project are paid a daily wage as well as food rations to recompense them for leaving their farms. Imported materials are being provided by UNCDF and supervision is being carried out by the Chief Technical Adviser and his counterpart and two UNV's and their counterparts. A tipper is available for moving materials and equipment and the supervision team have their own vehicles.

CONCLUSION

Any of these methods could be used with some modification to build school buildings using self-help. The Project now in progress at Bo Teachers College seems to offer the best current model as there is a high degree of organisation and technical assistance. To succeed, self-help projects must have assistance, particularly with transport and supervisions and they must also fit into a co-ordinated programme of school building.

Rural communities in Sierra Leone want schools for their children and are prepared to provide labour and locally available materials in order to build them. Their goodwill and enthusiasm must be encouraged and their efforts properly rewarded.

PART 2 : THE DESIGN OF PRIMARY SCHOOL FACILITIES FOR SIERRA LEONE

1. THE DEVELOPMENT OF THE DESIGNS

POLICY

An effective educational building planning policy can be defined as one which will lead to the construction of school buildings which are:

- of the right type, i.e. which responds adequately to the established educational requirements, the climatic conditions and which can also serve the local community;
- at the right location to ensure equality of access for all children to education;
- built and equipped at the right time to play their part in a co-ordinated building programme;
- built within the limit of the available funds, materials and labour.

RESEARCH AND DEVELOPMENT

After a period of research and development and through the construction of prototypes, standards or norms have been arrived at for furniture, classrooms and other building types which are illustrated in Part 2 of this section:

- the designs take into account the hot, humid climate prevalent over most of the country and the buildings therefore have large roof overhangs to keep off the rain and keep out the sun and have high rooms with plenty of cross ventilation to make rooms as comfortable as possible;

- the standard classroom is based upon government's proposed ultimate teacher:pupil ratio per class of 1:45 (44 at double desks) and upon anthropometric research into furniture sizes, space around furniture, viewing angles etc;

- furniture designs are based on timber sizes commonly available in the rural areas and require carpentry rather than joinery skills to construct them;

- commonly available materials are utilised for the construction of buildings with improvement where these can be made simply and cheaply. The buildings are designed to be constructed if necessary by village labour with some technical supervision and assistance;

- costs have therefore been kept as low as possible even though no overall budget for school construction exists.

SCHOOL MAPPING

As pointed out in Part 1, until a proper inventory and school mapping exercise is carried out it is not possible to establish the number or location of new primary schools that will be necessary or when they will be needed. This report therefore is designed as a handbook to be used, no doubt with some modifications, when these needs are better defined.

VILLAGE TECHNOLOGY

The need for the construction of a large number of primary school classrooms, particularly in the smaller settlements in the rural areas has already been established in Part 1. However it must be recognized that while traditional village technology and skills can build an adequate house where the maximum roof span is 10'0" or less, the skills needed to build a classroom with a clear span of 20'0" or more are of quite a different order. This is the main technical problem to be resolved in the construction of primary schools and various methods are now in use to solve it, most of them expensive, inappropriate or even unsound.

CONSTRUCTION METHODS

There are various methods by which primary school classrooms could be constructed in Sierra Leone:

1) One or more of the large building contractors based in Freetown could be employed, after due tendering procedures, to construct classrooms. Due to their high overheads and profit margins this would undoubtedly be very expensive and these large contractors would be very reluctant to work in the remote parts of the country where primary schools are required. They would also require some degree of supervision entailing the use of manpower and transport.

2) Smaller, regionally based contractors could be used. Their construction costs would undoubtedly be lower, but they would need assistance with administration, ordering of materials, advance payments, and transport. They would also require a great deal of technical supervision entailing high manpower and transport costs.

3) The third alternative is "self-help". As pointed out previously in Part 1, this also requires a great deal of supervision, the provision of transport, administration etc. and thus the supervision costs are very high, but probably not much higher than for alternative 2. The total cost of construction and supervision will probably be lower than for alternative 1, but with the advantages that money and skills will be brought into the rural areas and communities will become more involved in the construction and running of their own schools.

SELF-HELP

One important objective of the research and development was to see what part self-help could play in the construction of primary schools. Having established that, with proper supervision and assistance, self-help has a part to play, Section 2 which follows illustrates a range of simple furniture and buildings that could be constructed using this method, to the standards already established.

2. DESIGN CRITERIA AND STANDARD DESIGNS FOR FURNITURE AND FACILITIES

A. PRIMARY SCHOOL FURNITURE

Standard designs for chairs and desks have been developed using anthropometric data collected from two surveys of primary school children conducted in the Western Area Rural and in Bo District in 1987.

The chair design is a modified version of the ARISBR Chair used extensively in Asia. The desk has been developed from prototypes and is designed to seat two pupils (fig.3).

The criteria used in designing the furniture were that:

- the furniture should fit the range of body sizes established by the anthropometric surveys;

- chairs are preferable to benches for seating as they provide greater comfort and flexibility in use. They do not necessarily use more materials;

- chairs should provide good lumbar support and be designed to prevent rocking backwards on the rear legs which would loosen the joints;

- the desk should have an adequate working surface for two pupils and be very stable;

- recessed joints should be avoided; joints should be simple lap joints, glued and nailed or screwed together and thus be easy to make and repair by village carpenters;

- component pieces should be of as few different sizes as possible and easily cut from commonly available board sizes.

The chairs and desks have been designed in two sizes, one size to fit 6-9 year olds (figs. 4 and 5) and one size to fit 9-12 year olds (figs. 6 and 7); they are designed to be made from 1"x12" or 1"x10" boards. All joints are lap joints, glued, nailed and/or screwed.

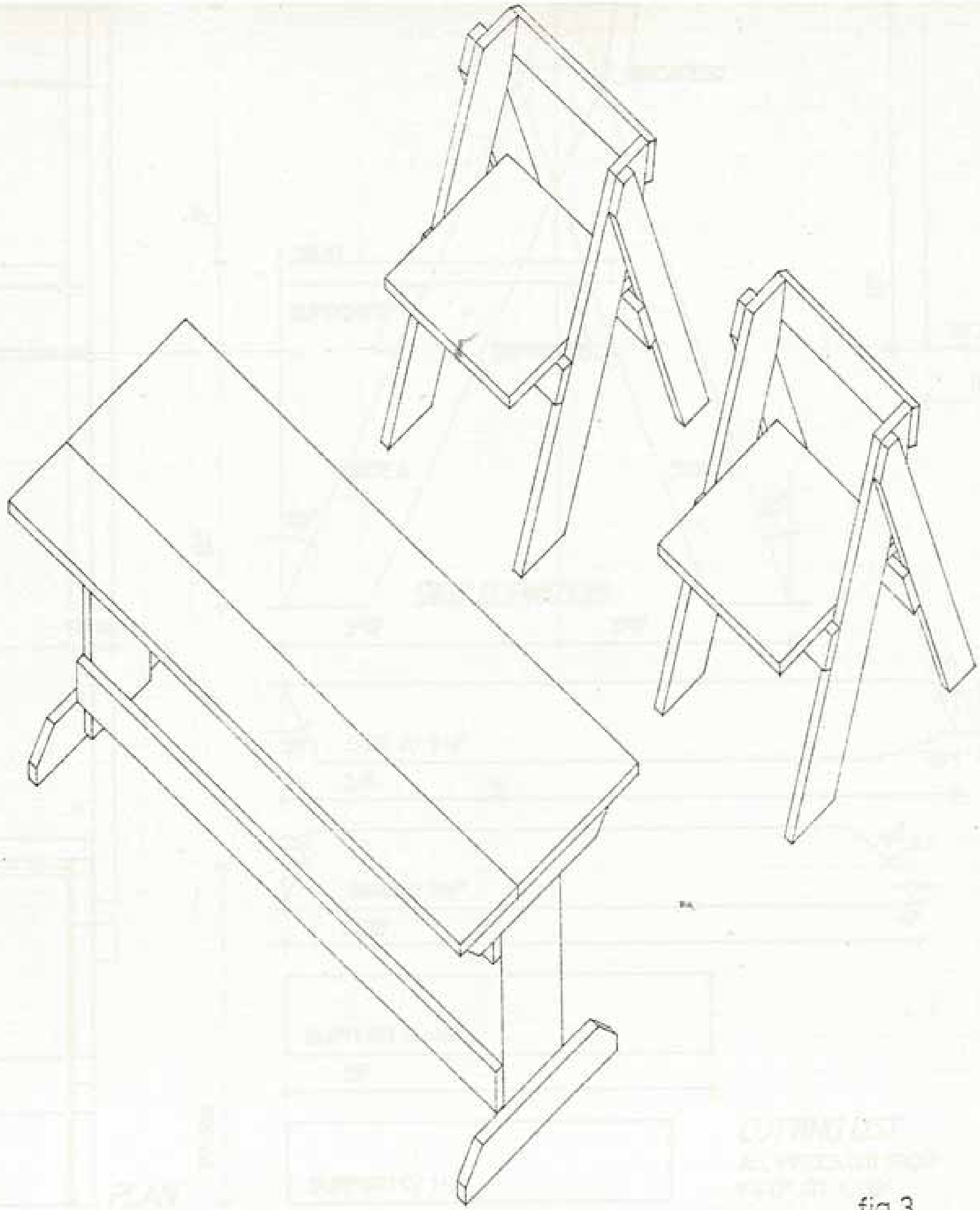


fig.3 axonometric view

standard classroom furniture

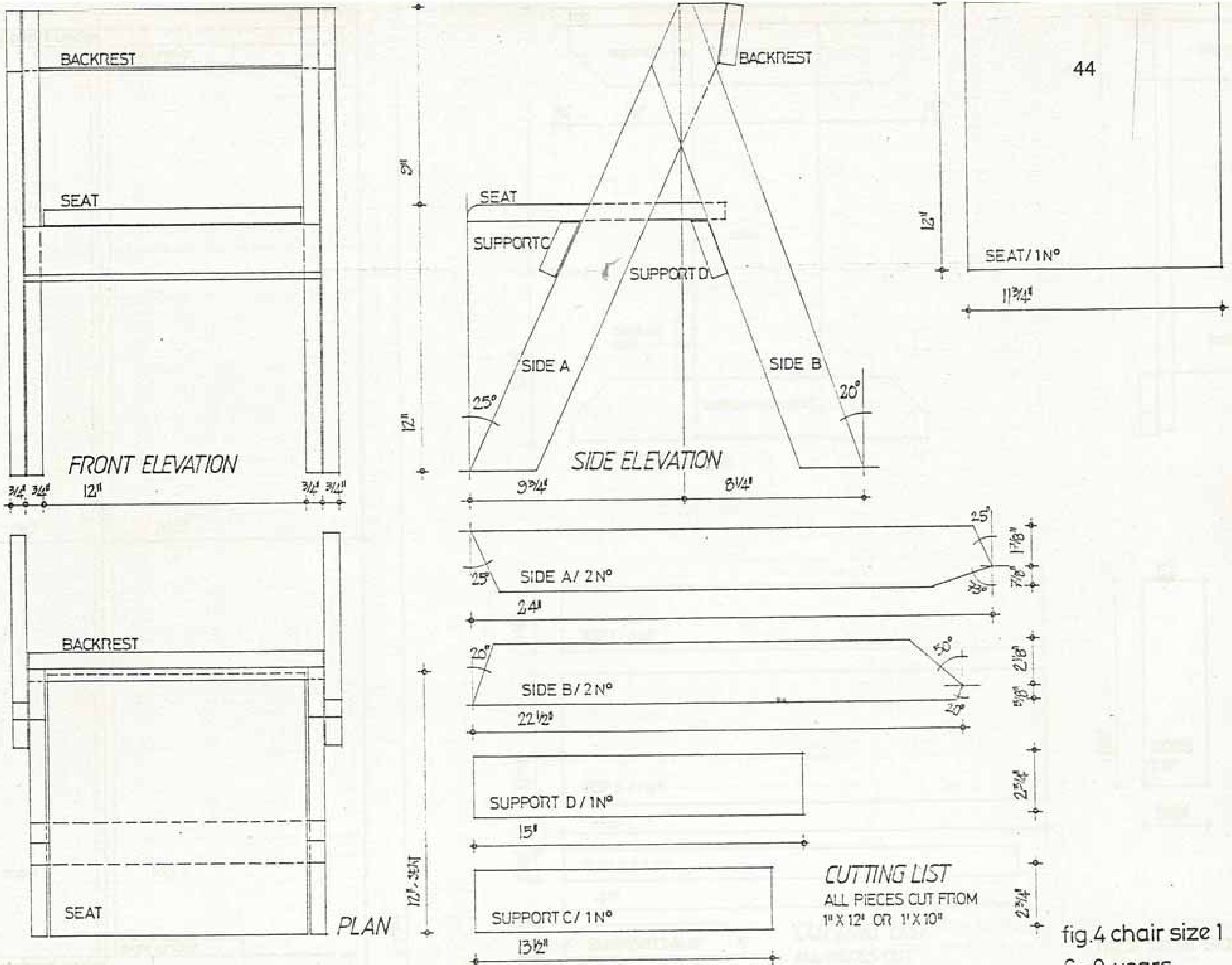


fig.4 chair size 1
6-9 years

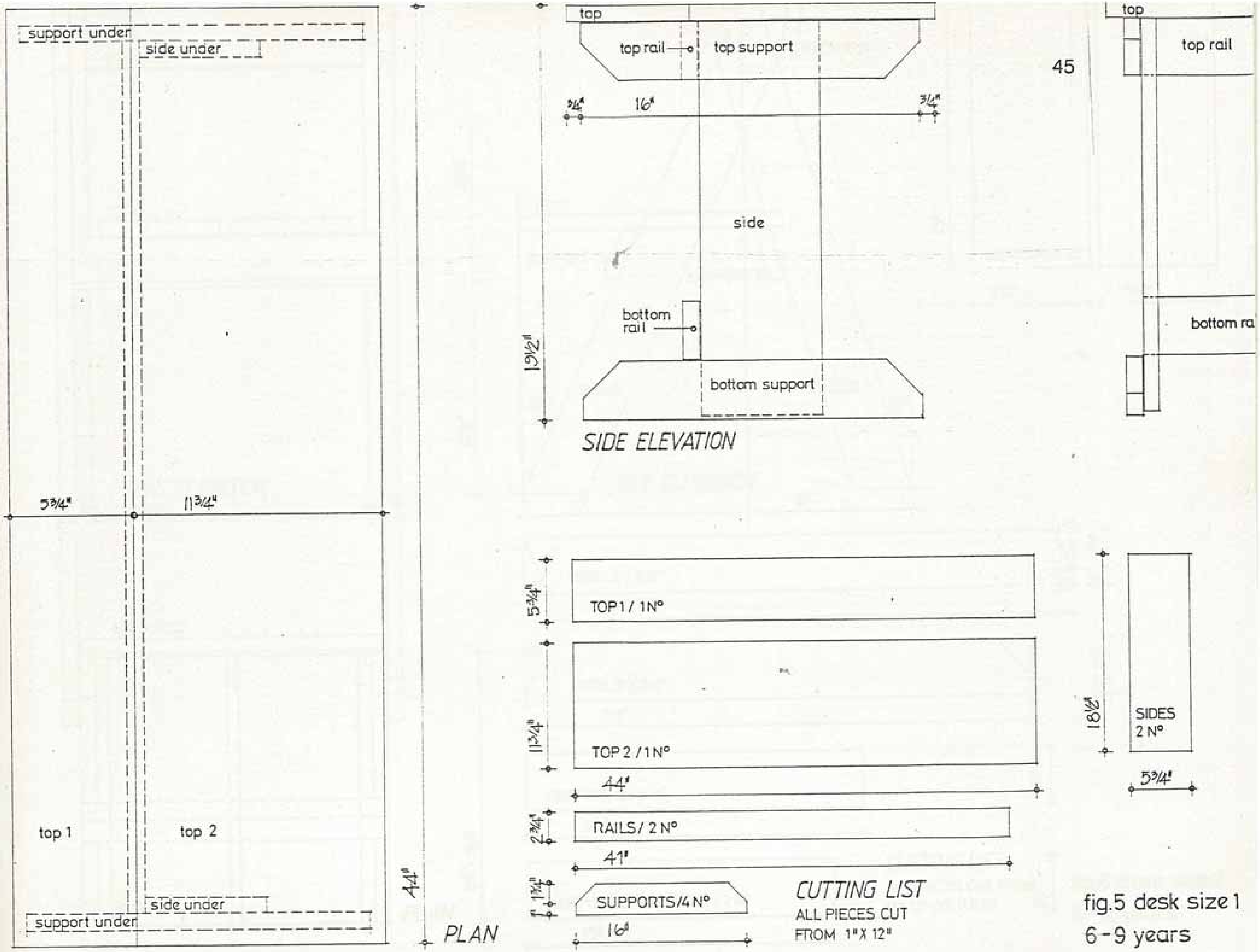


fig.5 desk size 1
6–9 years

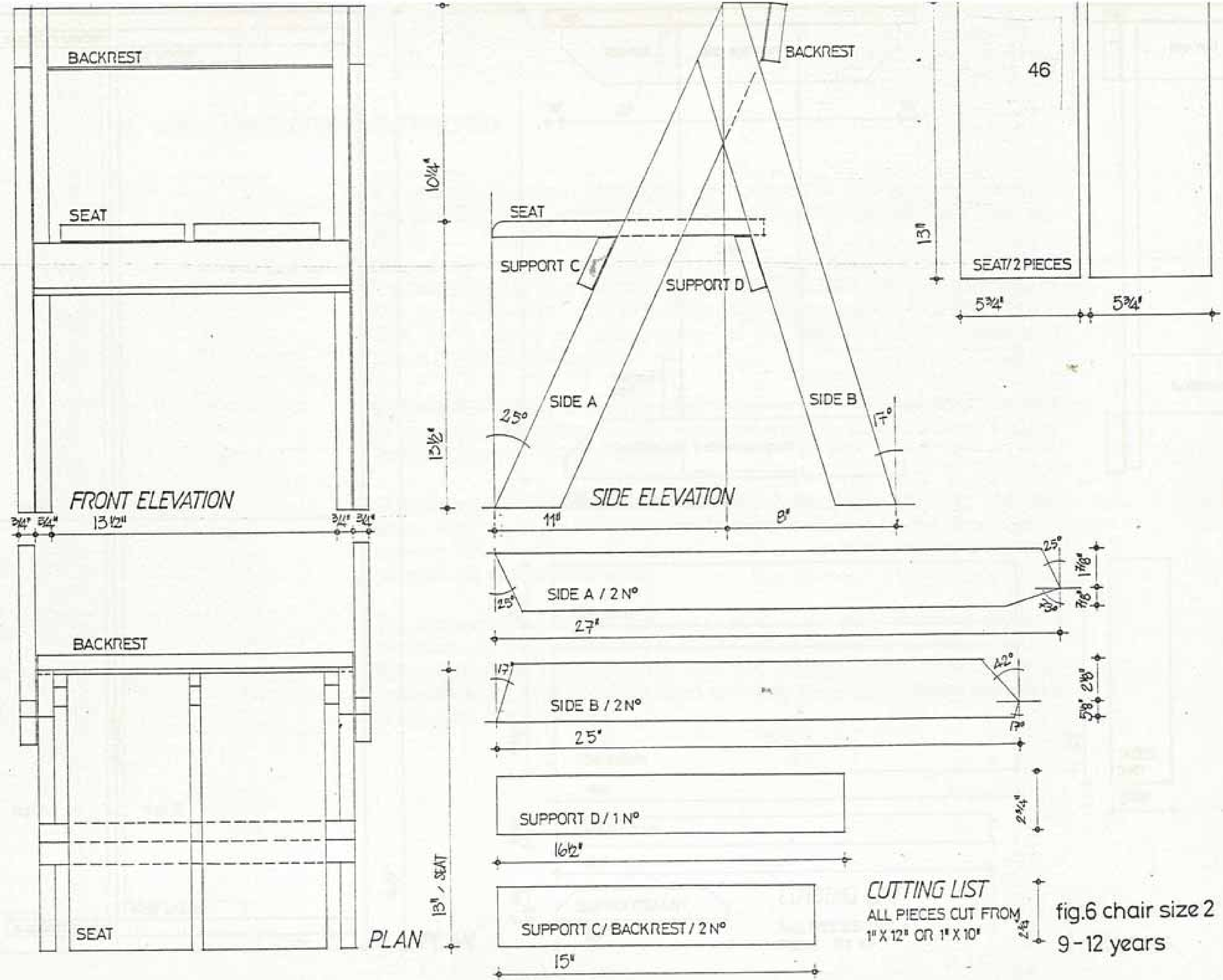


fig.6 chair size 2
9-12 years

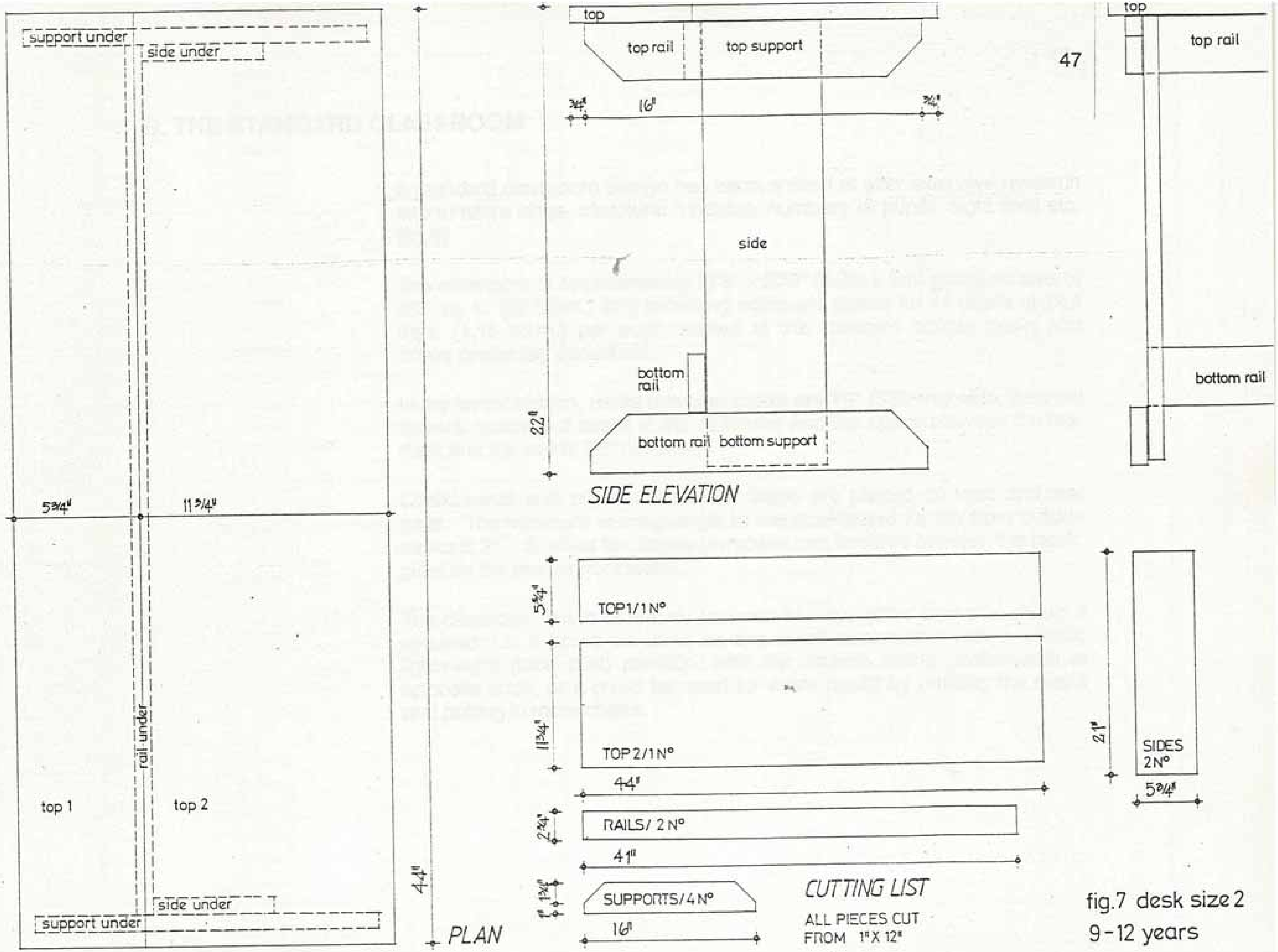


fig.7 desk size 2
9-12 years

B. THE STANDARD CLASSROOM

A standard classroom design has been arrived at after extensive research into furniture sizes, structural modules, numbers of pupils, sight lines etc. (fig.8)

The classroom is approximately 27'6" x 20'0" (8.3m x 6m) giving an area of 550 sq. ft. (50 sq.m.) and providing adequate space for 44 pupils at 12.5 sq.ft. (1.15 sq.m.) per pupil, seated at the standard double desks and chairs previously described.

In the layout shown, aisles between desks are 1'9" (533mm) wide, the front to back spacing of desks is 2'0" (610mm) and the space between the rear desk and the wall is 2'6" (762mm).

Chalkboards and pinboards or tack strips are placed on front and rear walls. The minimum viewing angle to the chalkboard for the front outside desks is 35°. Shelves for display purposes can be fitted between the block piers on the rear or front walls.

The classroom could obviously be used in ways other than that shown if required; i.e. it could be used as two small classrooms with a central, lightweight (local mat) partition, with the classes facing chalkboards at opposite ends, or it could be used for more pupils by omitting the desks and putting in more chairs.

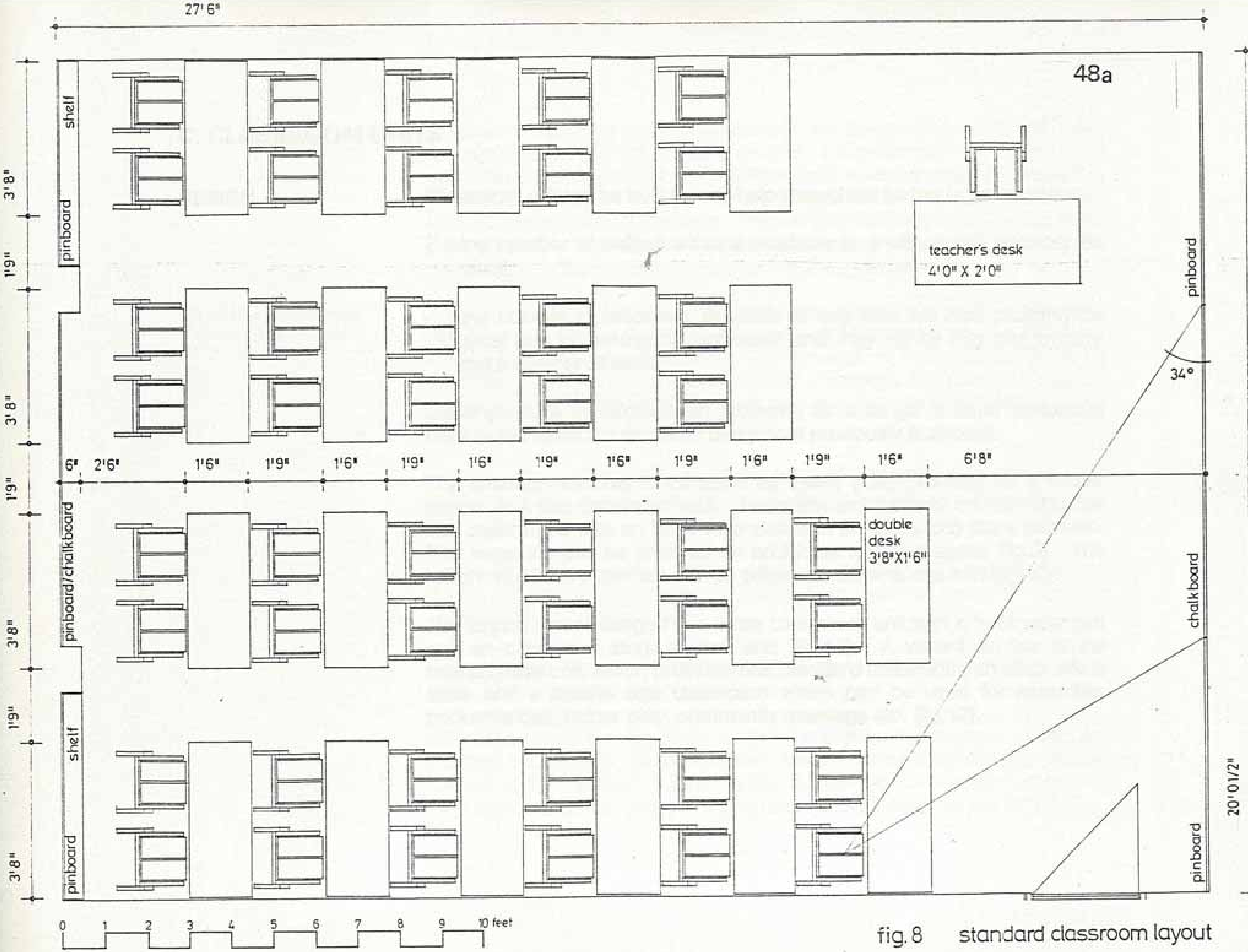


fig. 8 standard classroom layout

C. CLASSROOM UNITS

DESIGN

Classroom units to be built by self-help should not be too large because:

- the number of skilled artisans available in a village will probably be small;

- the number of labourers available at any time will also probably be small due to farming commitments and they will be required to carry out a number of tasks.

Drawings have therefore been prepared for a range of small classroom units based upon the standard classroom previously illustrated.

The smallest unit that is foreseen as being built, probably as a feeder school, is a two classroom unit. There are two variants on this: one has two classrooms with an inset verandah and an office and store between. This verandah can be used as an additional teaching space (fig.9). The other has a front verandah with an office and store at one end (fig.10).

The largest unit envisaged is a three classroom unit with a front verandah and an office and store at one end (fig.11). A variant on this is the multipurpose unit, which provides one standard classroom, an office and a store and a double size classroom which can be used for assembly, performances, indoor play, community meetings etc. (fig.12).

Other units using the standard classroom are obviously possible such as a two classroom unit with an open covered space between which could be used as a workshop (fig.13). These units can be used for extending schools or constructing new ones, a new school consisting of two or more units of two or three classrooms. This will give flexibility in the layout, make better use of available sites and make possible the addition of classroom units as and when the need arises or finances are available.

STRUCTURE AND CONSTRUCTION

The classroom buildings illustrated are designed to be built using stabilised-soil blocks (nominal thickness 6") produced on the BREPAC, CINVA RAM or similar machines. The dimensions indicated are those for the BREPAC block using a timber insert. However the principles and the main dimensions of the design can be used for other materials such as mud blocks or sandcrete blocks.

Long lengths of 6" block walls of any material are likely to crack; therefore to minimise this, and to stiffen the walls, block piers of varying depths have been introduced.

Along the window walls the piers are spaced at 7'0" (2.13m) centres and these, as well as stiffening the walls form, with a concrete capping, supports for the roof trusses.

The standard classroom consists of four structural bays, a total length of 28'0", usually less the thickness of one wall.

All trusses have a clear span of 20'0 " and if bushsticks are utilized for trusses and purlins, each standard classroom will have three trusses spaced at 7'0" centres. If sawn timber is available for trusses and purlins, only one central truss need be used together with deep purlins (6" x 2"s).

The roof structure as shown has been designed for the use of two 8'0" long C.I. sheets with a 9" end lap. Where a front verandah is required an additional 6'0" sheet is required. With slight modifications an alternative roofing material such as fibre-concrete tiles could be used. Details of these are given in Part 3.

Foundations are designed to be built of stone laid in cement mortar or of sandcrete blocks laid on a concrete footing. Whichever is used the foundations must be raised at least 1'0" above ground level before the stabilised soil blocks are started.

The floor as shown is a 3" (75mm) concrete slab laid on fill. An alternative could be sand-cement tiles laid on a cement mortar bed. Details of these are given in Part 3.

Ceilings are shown and should be provided if at all possible. They can be made of softboard, hardboard or local mats nailed to the underside of the purlins.

Doors and shutters are shown made of local hardwood. If the frames are built into the walls as they are constructed, concrete lintels are unnecessary. If funds are not available to provide shutters, adequate light and ventilation can be provided to classrooms through panels of open blockwork.

The standard 7'0" bay described above is too narrow for offices and stores and therefore where these are required in classroom units with a front verandah, a wider bay, 10'1" (3.07m) centre to centre is used.

Using the standard 7'0" bay smaller or larger units can be built. Three bays will provide a classroom 20'0" (6.24m) long which is adequate for 28/30 pupils. Five bays or more will provide a room large enough for meetings, drama etc.

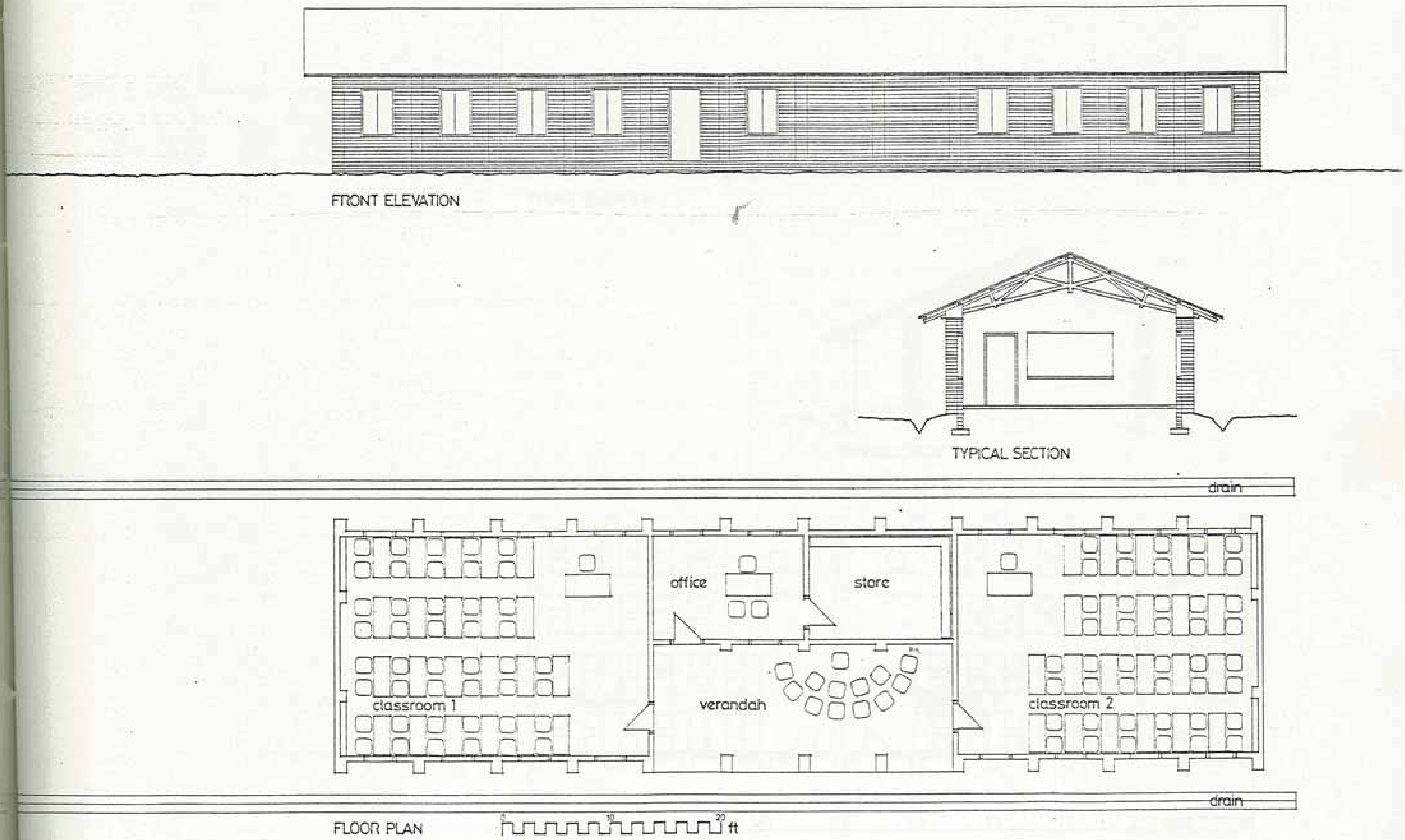


fig.9 2 classroom unit with inset verandah

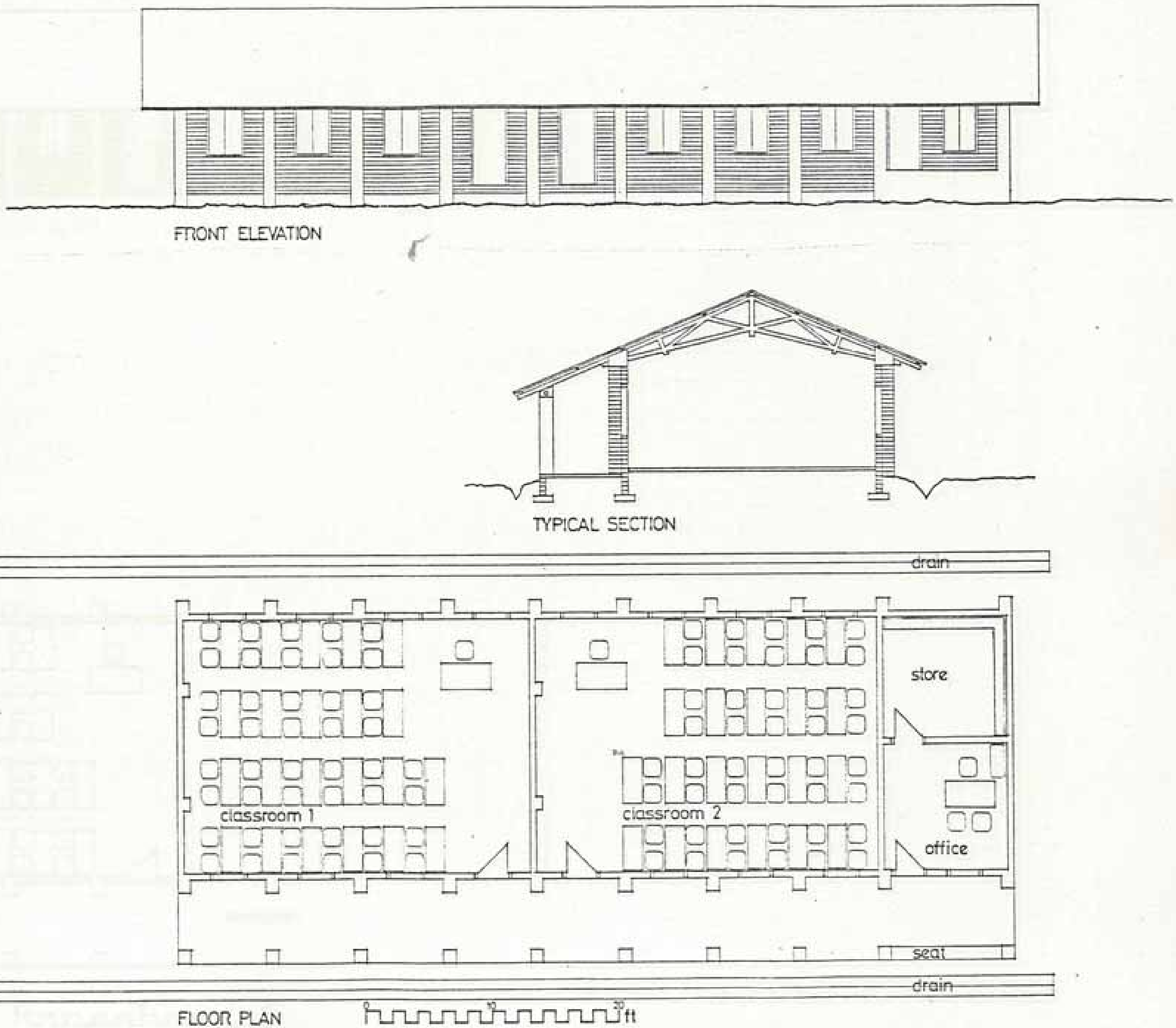


fig.10.2 classroom unit with front verandah

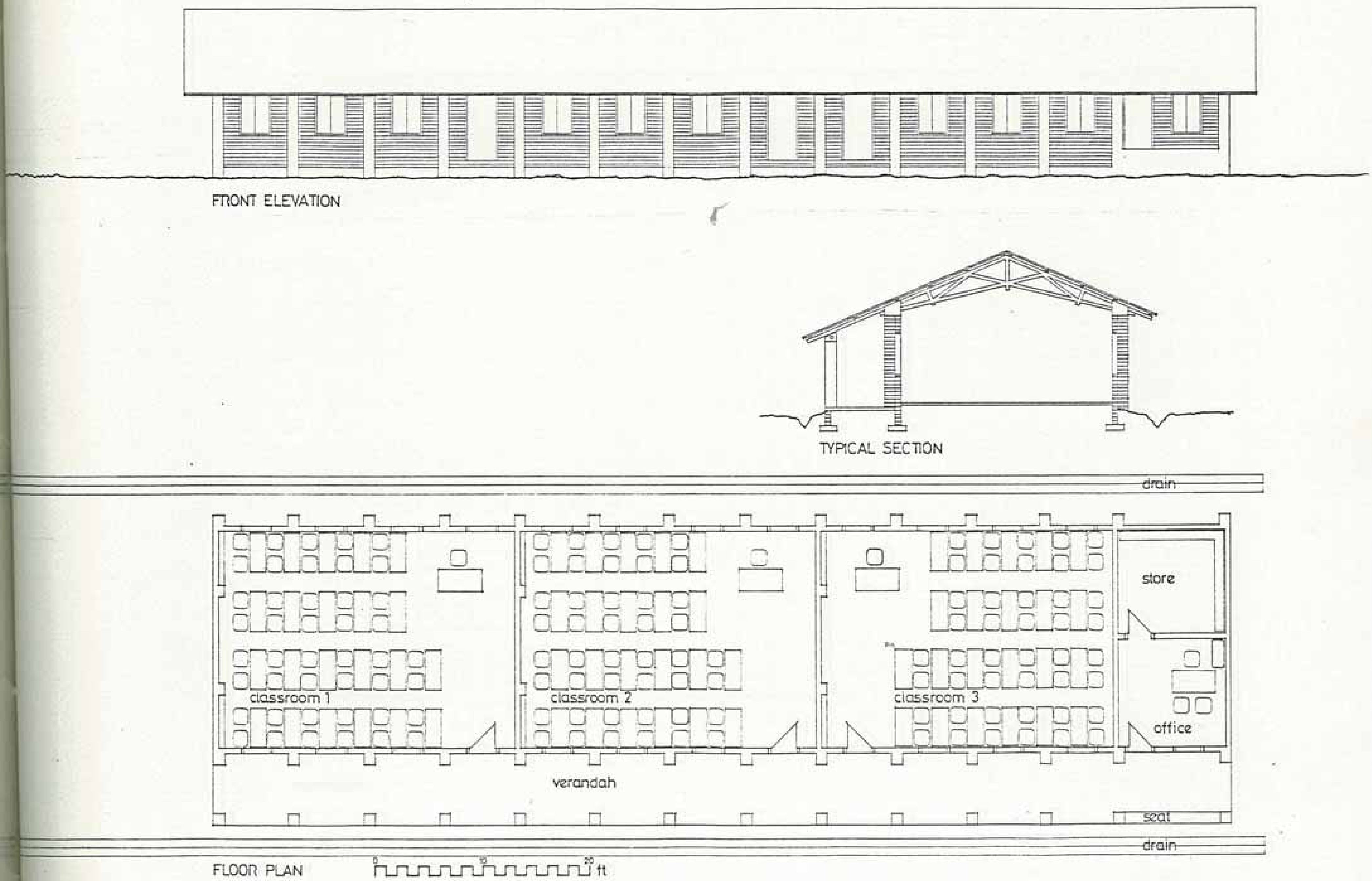


fig.11 . 3 classroom unit with front verandah

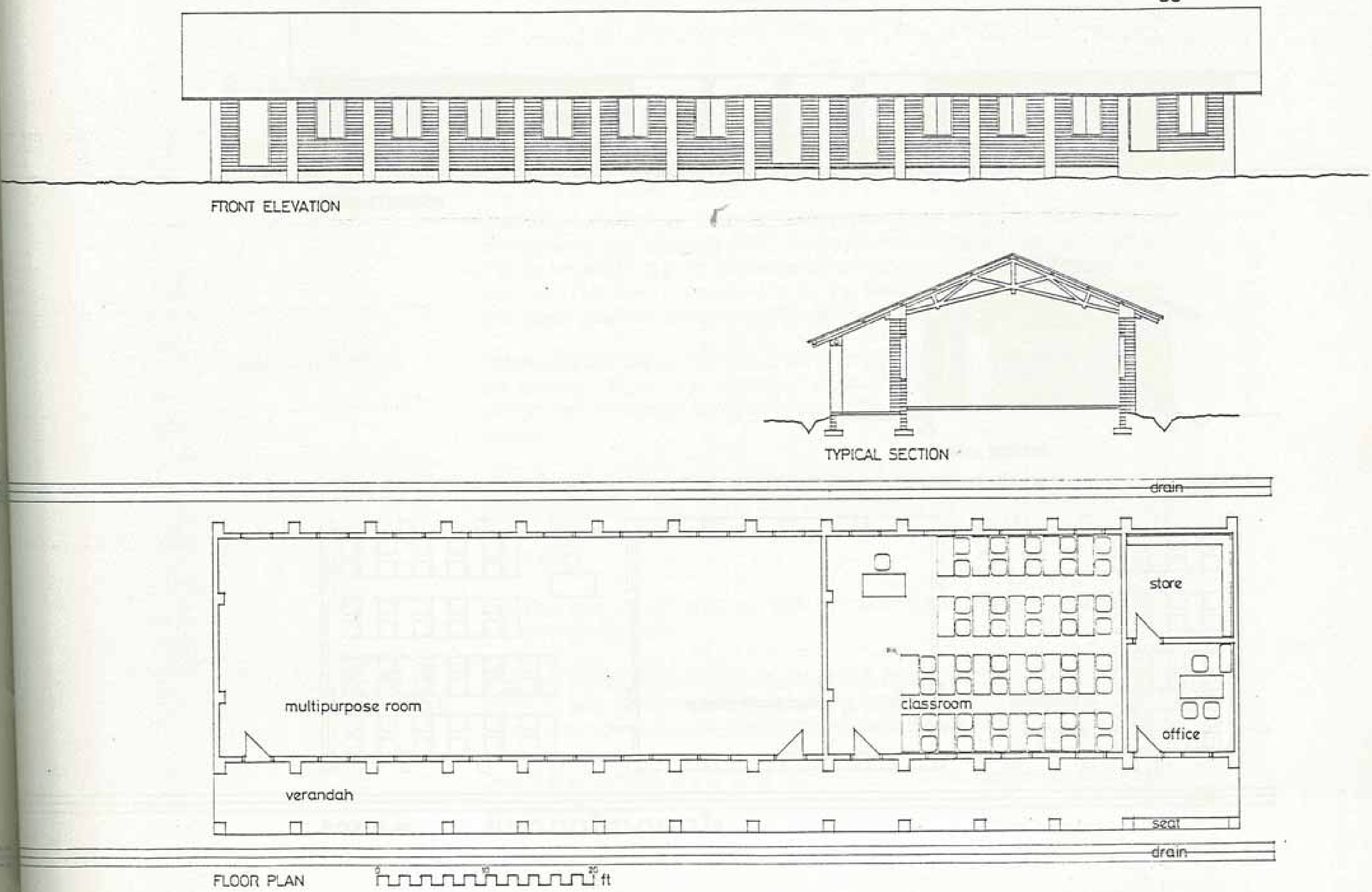


fig.12 multi-purpose unit with front verandah

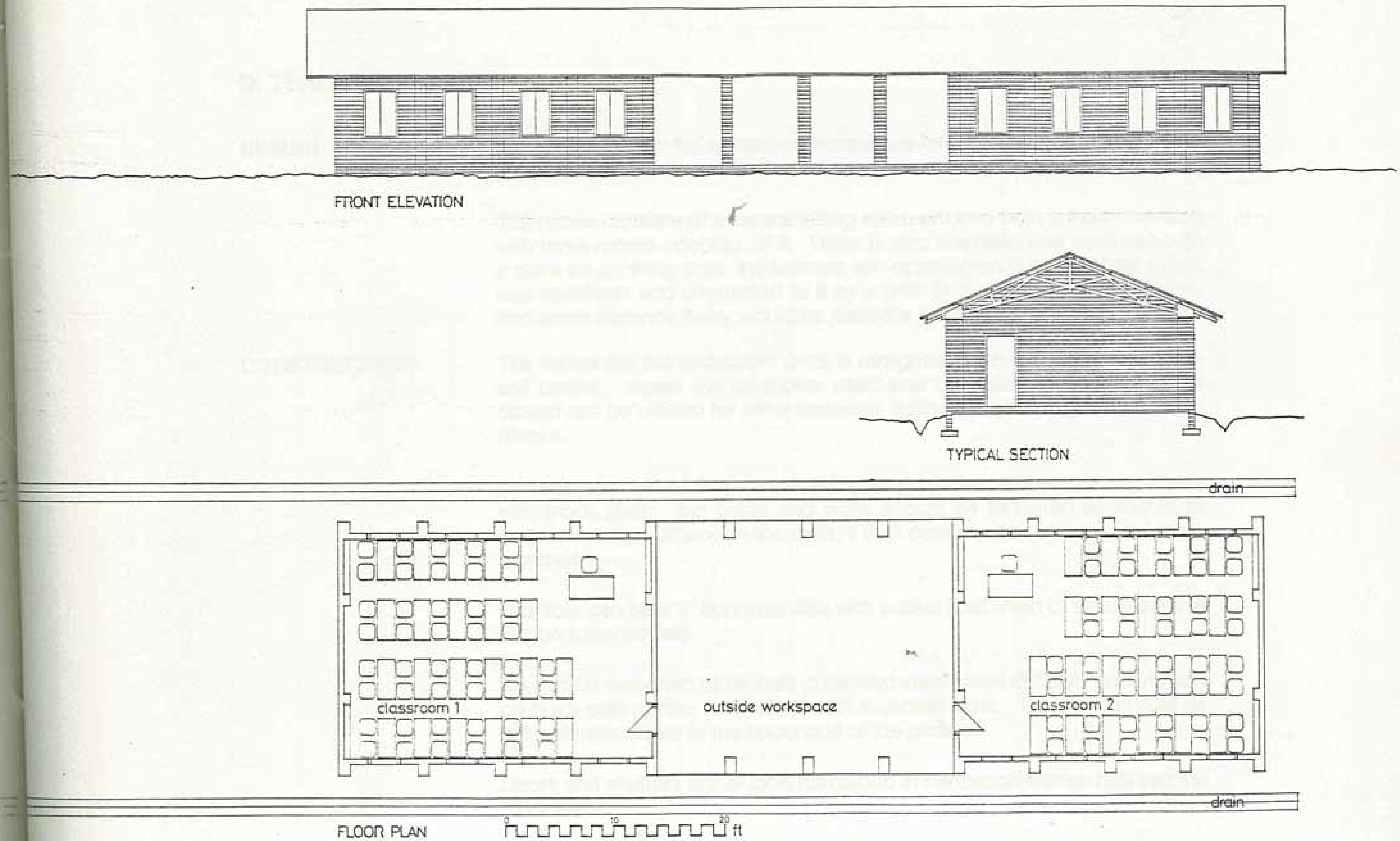


fig.13 2 classroom unit with covered workspace

D. TEACHERS HOUSE

DESIGN

A standard design for a teachers' house has been developed based on the village house that is now found in most parts of Sierra Leone (fig.14).

The house consists of a central sitting room entered from a front verandah with three rooms opening off it. There is also a smaller rear verandah with a store for cooking pots, implements etc. opening on to it. Adjacent to this rear verandah and connected to it by a path is a covered outside kitchen and some distance away would be placed a pit latrine/washroom.

CONSTRUCTION

The house like the classroom units is designed to be built using stabilised-soil blocks. Again the principles used and the main dimensions of the design can be utilised for other materials such as mud blocks or sandcrete blocks.

All walls are built of 6" (nominal thickness) blocks stiffened as necessary with block piers. the gable end walls should be rendered as should all walls internally. Otherwise the walls, if built carefully can be left unrendered externally.

The floor can be a 3" concrete slab with a steel float finish or sandcrete tiles laid on a mortar bed.

The roof is designed to be built of profiled steel sheet or fibre concrete tiles on bush pole purlins and rafters with a central truss. The ceiling could be of local mats nailed to the underside of the purlins.

Doors and shutters are of local hardwood in hardwood frames built into the block walls.

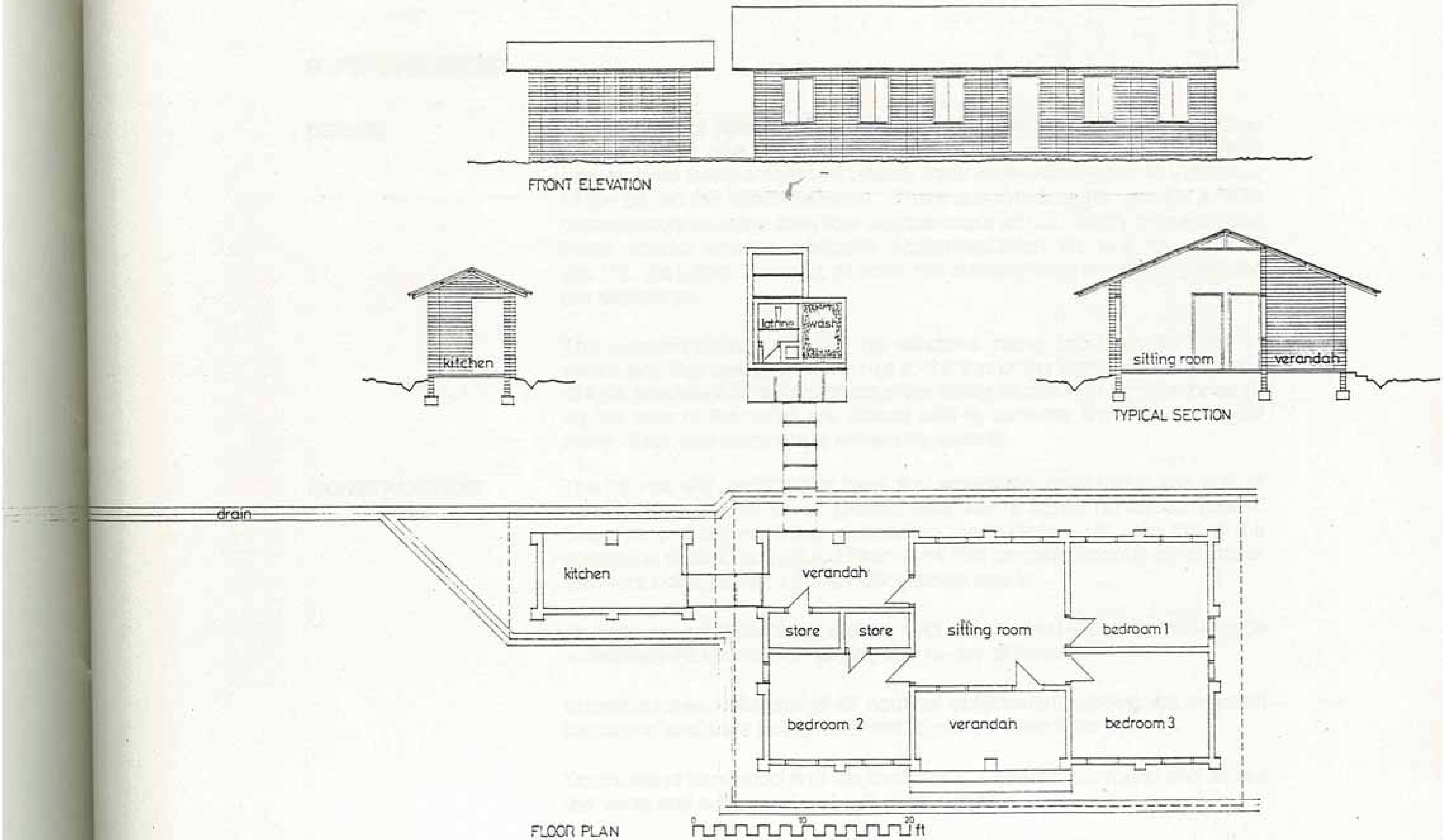


fig.14 teachers house

E. PIT LATRINES

DESIGN

The majority of schools do not have running water and thus any latrine provision must take the form of pit latrines. Standard designs for multiple latrines have been developed based, particularly with regard to ventilation of the pit, on the latest research. There are two designs, one for a three compartment and one for a four compartment latrine. Singly or in multiples these should provide adequate accommodation for any rural school (fig.15). As a rule of thumb, at least one compartment should be provided per classroom.

The compartments are dark, no windows being provided, in order to attract any flies breeding in the pits to the top of the vents, the only source of light (the holes in the squatting slabs being closed with wooden covers). As the tops of the vents are closed with fly screens, the flies should die there. Each compartment is separately vented.

CONSTRUCTION

The latrines are designed to have the separating walls to the pits built of sand/cement blocks up to ground level with a lightly reinforced ground beam around the perimeter supporting the outside walls. On top of the sandcrete blocks and ground beams are laid precast concrete slabs, some with vent holes, others with squatting holes cast in.

The pits extend behind the latrines and are covered with removable slabs to facilitate the eventual emptying and re-use of the pits.

Superstructure walls are of 6" nominal soil/cement blocks; the exposed bents and end walls being rendered to protect them from the rain.

Doors are of hardwood and the roof is of C.I. sheets, cut round and let into the vents and supported on bush-stick purlins.

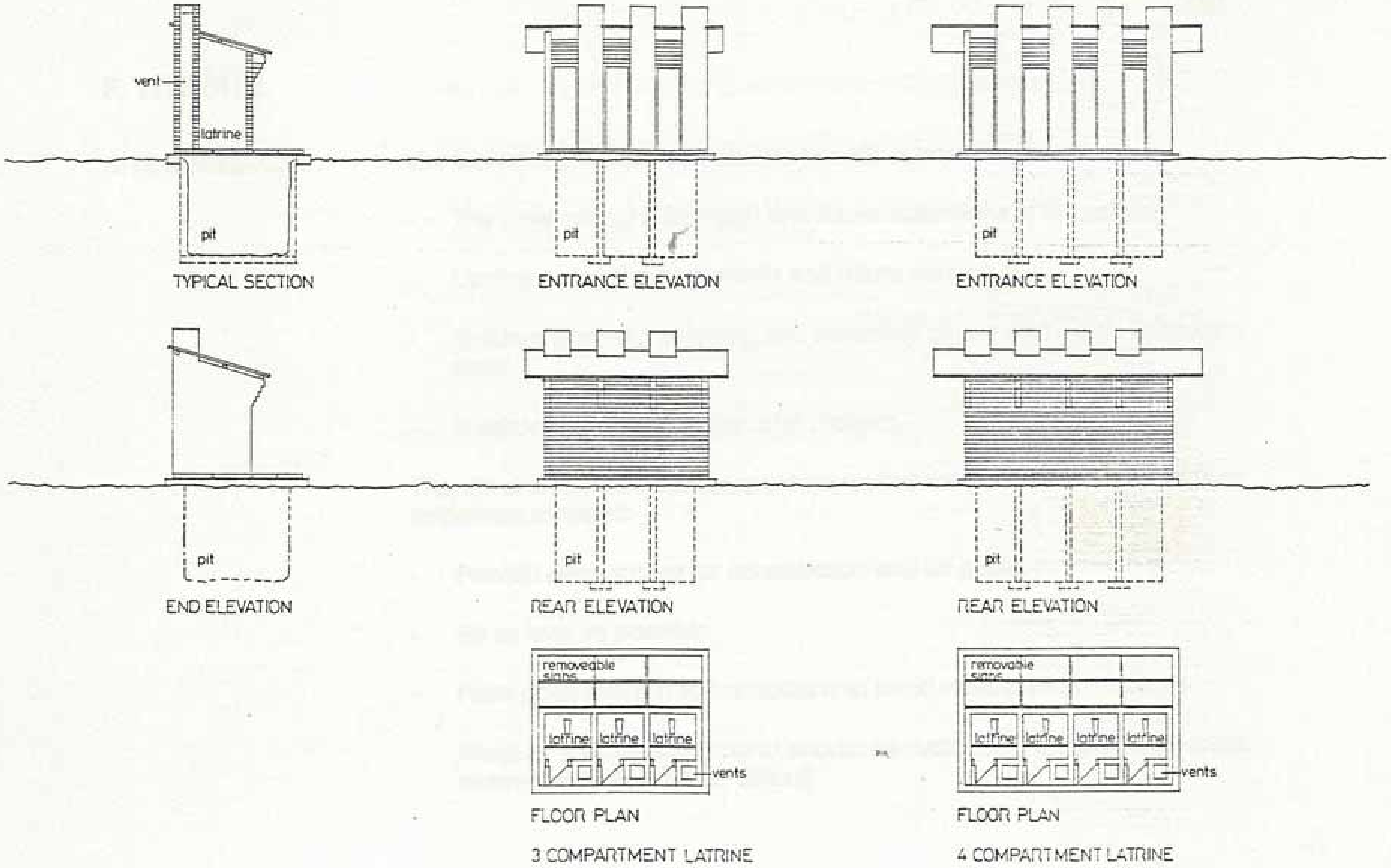


fig.15 pit latrines

F. THE SITE

SITE SELECTION

The site selected should if possible provide adequate space for:

- The initial school building(s) and future extensions of the school
- Latrines for staff and students and future staff houses
- Outdoor (shaded) teaching and assembly places and a safe recreation area.
- A school vegetable garden and orchard.

The site should if possible be adjacent to, but not too close to the village or settlement and also:

- Provide easy access for construction and for pupils
- Be as level as possible
- Have good uniform soil conditions to avoid expensive foundations
- Areas of soft marshy ground should be avoided as should rocky areas where excavation will be difficult

- Be naturally well drained to avoid the possibility of flooding

- Be situated away from roads carrying vehicular traffic

- Have access to a safe water supply, or have the possibility of obtaining water from a well sunk on the site.

Thus a good site for building a school would be on the edge of a village set back from the road with a flat elevated area on which to place the school buildings. The land should slope gently in one direction to a swamp where a vegetable garden could be established and on the edge of which a well could be sunk; and in the other direction have access to an area of level ground that could be used as a playing field (fig.16).

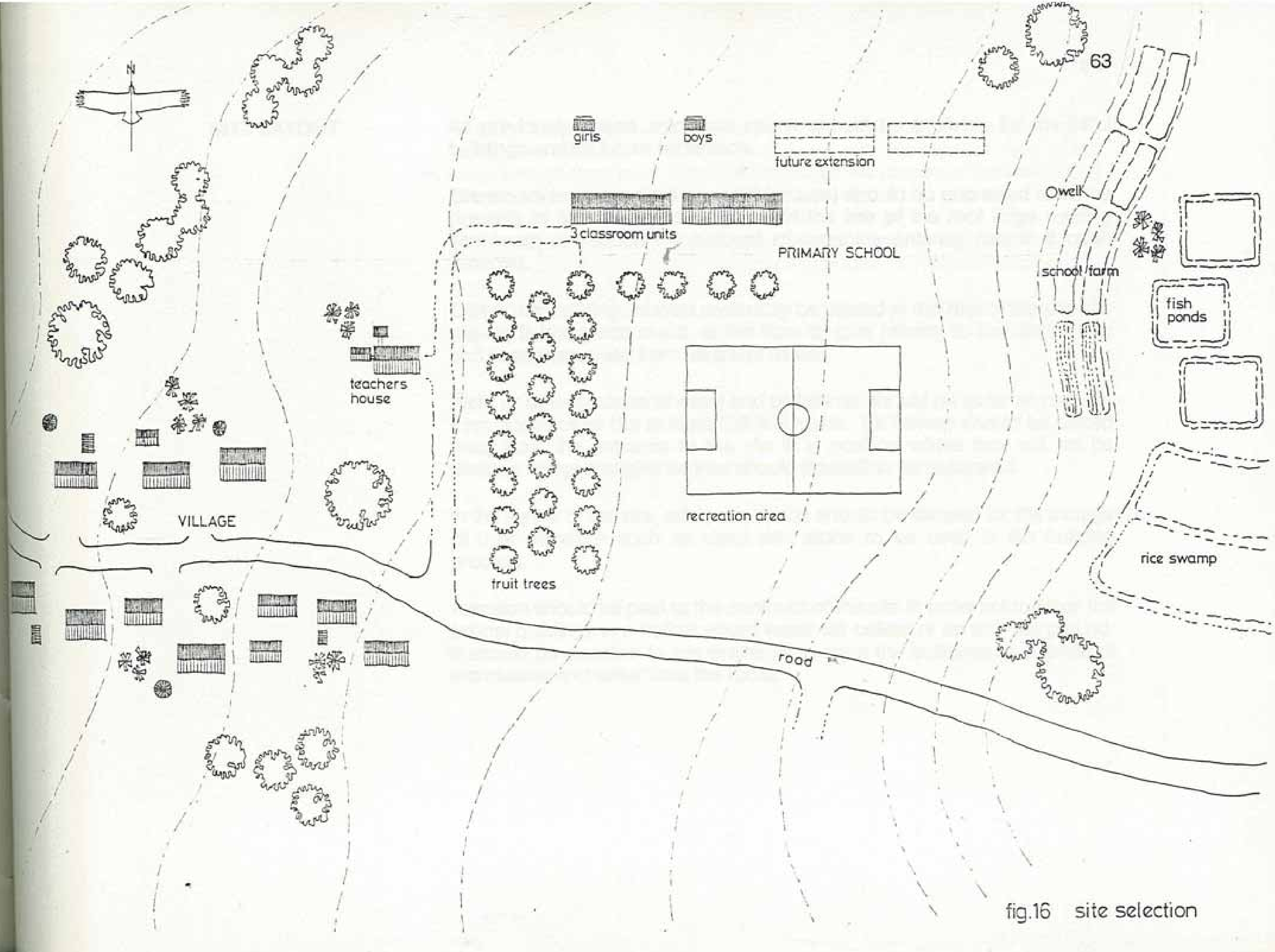


fig.16 site selection

SITE LAYOUT

As previously stated, adequate space should be available for the initial buildings and for future expansion.

Classroom buildings (and any staff houses) should be orientated as far as possible to face north/south (i.e. with the line of the roof ridge running east/west) to reduce the amount of sunshine entering rooms through windows.

Classroom buildings should preferably be placed at the rear of the site with playing fields, gardens etc. at the front to give privacy to the classrooms and keep them away from vehicular roads.

Wells or other sources of water and pit latrines should be as far as possible from one another but at least 100 feet apart. Pit latrines should be placed away from the entrance to the site in a position where they will not be obvious. Boys and girls latrines should if possible be separated.

In the layout of the site, adequate space should be allowed for the storage of bulk materials such as sand and stone to be used in the building process.

Attention should be paid to the contours of the site in order not to place the school buildings in a hollow where water will collect or on soft wet ground. It should be possible to run drains away from the buildings to dispose of stormwater and water from the roofs.

Buildings should not be placed too close to large trees whose roots could damage foundations, or whose branches could damage the roof; or too close to thick farm bush which will cut down the amount of breeze flowing through the buildings.

Classroom units should not be built too close together to avoid the noise from one class interrupting teaching in another; a minimum distance of 60'0" should be adequate (fig.17).

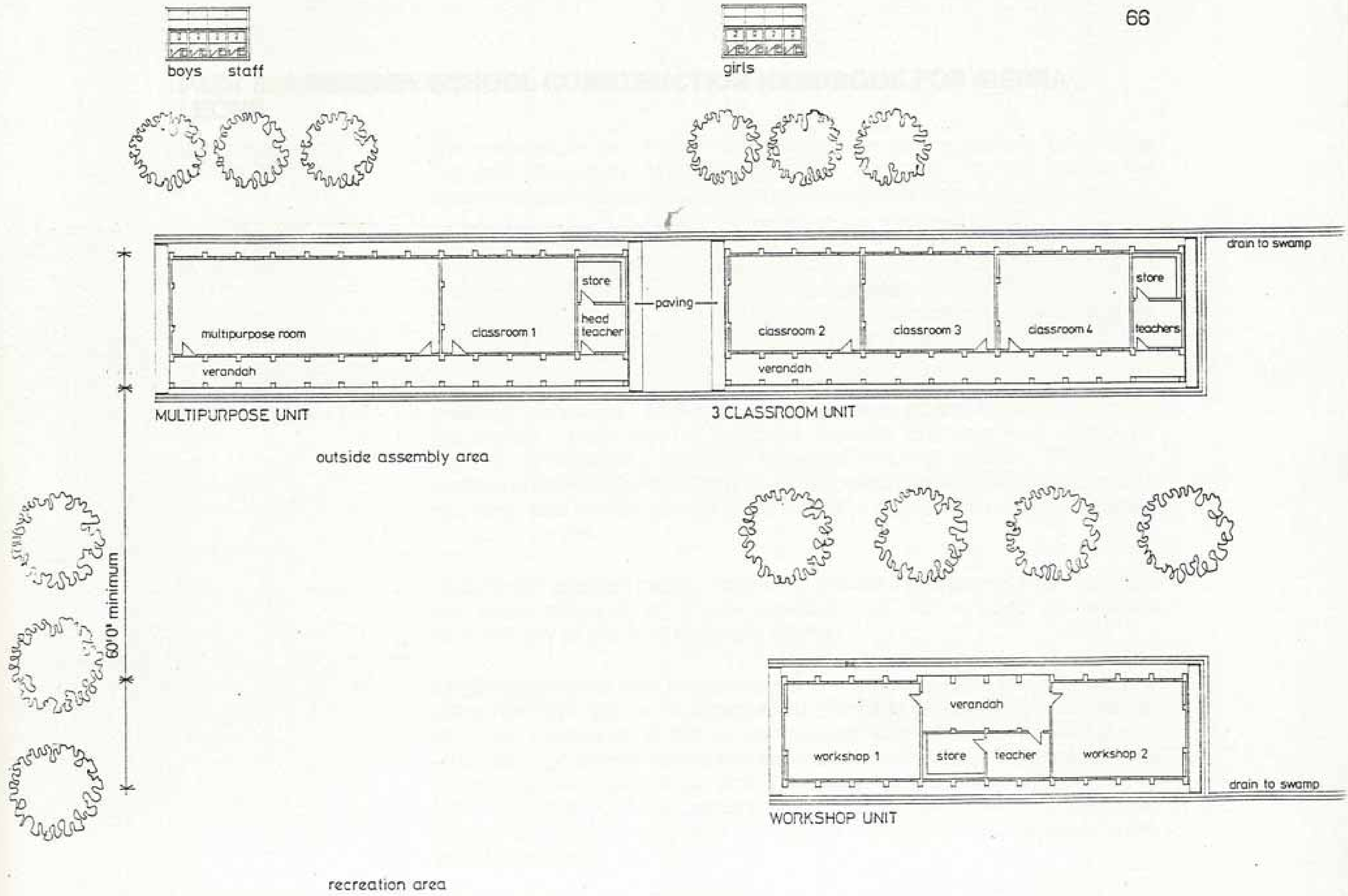


fig.17 site layout

PART 3: A PRIMARY SCHOOL CONSTRUCTION HANDBOOK FOR SIERRA LEONE

1. BUILDING MATERIALS

MATERIALS FOR CONSTRUCTION

The materials to be used in the construction of the primary schools as designed have been briefly described in Part 2 B. In this section the available materials and possible improvements are more fully discussed.

TRADITIONAL MATERIALS

Traditionally, houses, court barries and other small buildings in Sierra Leone have been built of a very restricted range of materials. Sun dried bricks or wattle and daub (sticks and mud plaster) are used for walls; grass thatch or tiles made of palm leaves on bush pole structures are used for roofs; doors and shutters are made from local timber.

IMPROVED MATERIALS: WALLS

The possibilities for improving constructional techniques using local materials are limited. There is a virtual absence of any naturally occurring pozzolanas. There are no limestone deposits and thus lime cannot be used as a stabilizing agent or for manufacturing cement. This latter material is imported in the form of clinker which is then processed locally. However, due to high energy costs in Sierra Leone it is probably cheaper to import cement.

Oysters are cropped locally, especially around the Western Area and there are small amounts of shells available but not enough to process economically to produce a supply of lime.

Large quantities of rice are produced in the country and the possibility of using rice husk ash as a substitute for Portland cement has been looked into. The economics of this do not however seem viable at present due to - the fairly high capital costs involved; the fact that at best rice husk ash has to be mixed with cement (or lime if available) to a maximum proportion of 30% RHA:70% Portland cement; and to the high costs of transporting cement for use in mixing and the cost of rebagging and transporting the finished product.

There are very few clay deposits in the country and no tradition of producing fired clay bricks in the villages. Clay bricks do not therefore offer a viable alternative for improved walling.

There would seem to be two ways of improving wall construction:

1) To improve the ways sun dried blocks are used to give them a longer life. If mud blocks are given proper foundations, either of concrete or stone, which are taken up at least 1'0" above ground level, if the walls are given generous roof overhangs so that they are not soaked by rain, and if they are rendered with the correct mix of cement and sand render, a mud block wall can last indefinitely. There are plenty of examples of buildings in Sierra Leone built of mud blocks which are 30, 40, even 50 years old.

2) To stabilize mud blocks using small amounts of cement (between 5% and 10% depending on the soil) and compressing the blocks in a CINVA-RAM or similar machine. This will produce a block which, if used and protected correctly, need not be rendered but will have a long life. Reference is made in other parts of this Report to the BREPAC machine which is an improvement on the CINVA-RAM machine and which produces a highly compressed block which looks very good unrendered, if laid neatly, and which will have a long life. Details of this machine are given in Annexe 1.

IMPROVED MATERIALS: ROOFS

The only real substitute for thatch in Sierra Leone has been, up to very recently the profiled steel sheet (locally referred to as 'pan' or corrugated iron). There is no production facility for these and they therefore have to be imported. The sheets imported by local merchants are generally of poor quality and are very expensive. However local carpenters are used to using them and even in the remotest parts of the country a carpenter can usually be found who can erect a passable roof.

There is now another alternative, the fibre concrete roof tile or sheet. These have been developed with varying degrees of success by a number of organisations around the world. Several machines made by Parry Associates (Intermediate Technology Workshops) which produce a pantile or roman tile made of sand, cement and a natural fibre, have been imported into Sierra Leone over the past few years and have been producing tiles with, again, varying degrees of success. The machine can be either hand or battery powered. If properly used it can produce a very good product which, in Sierra Leone, is substantially cheaper than imported steel roof sheets. However the process does require a lot of supervision and good quality control and as it is a technology that is completely new to local carpenters, erection also requires a great deal of supervision. However in the right circumstances the roof tile could make a contribution to lowering the cost of building. Details of the machine are given in Annexe 2.

IMPROVED MATERIALS: FLOORS

Floors to low cost buildings in the rural areas have traditionally been of beaten earth. If funds are available a thin sand and cement screed is applied and if a "proper" floor can be afforded a concrete slab is laid, with or without a finishing screed.

A hard wearing, non-dusting floor is essential in a primary school; one that will stand up to the hard wear inflicted by children and furniture. It is virtually impossible to get a properly laid screed in Sierra Leone even under controlled circumstances and therefore the only viable floor finish until recently has been a steel float finish concrete slab (mix 1:3:6). However the roof tile machine referred to above also produces a vibrated, sand and cement floor tile, approximately 3/4" thick which seems to be a very good substitute for concrete.

The main problem with producing good quality concrete floors is the difficulty in obtaining crushed aggregate at reasonable prices in nearly all parts of the country. The use of floor tiles would reduce drastically the amount of stone needed for building and, because the tiles are vibrated, if they are properly made and cured, they should provide a superior wearing surface. Details again are given in Annexe 5.

2. METHODS : A GUIDE TO CONSTRUCTION

AIMS

This section offers a step by step guide to constructing a typical unit. It is designed to be used by a technician with some basic building skills and could also be used as a training tool. It would be used in conjunction with a complete set of working drawings for the building.

MATERIALS

The guide assumes the use of sand and cement blocks on concrete footings with soil-cement blocks above foundation level. Alternative foundation types are indicated and alternative wall types such as mud blocks or sandcrete blocks could be used above ground level.

CURING

Any material that uses cement in its manufacture must be properly cured, be it sand and cement blocks, soil-cement blocks or fibre-concrete roof tiles or floor tiles. If the BREPAC or the Parry Associates machines are used (Annexes 1 and2) detailed instructions for using the machines and curing the blocks or tiles come with the machines. These must be followed.

COSTING

As a guide to costing, a breakdown of materials for a two classroom and a three classroom unit is given in Annexe 3. A list of tools required on a typical site is given in Annexe 4.

A. PREPARATION OF THE SITE

The site selected should be as level as possible and on firm ground.

The whole site must first be cleared of vegetation in order that the buildings can be positioned and set out.

The buildings must, if possible, be orientated to face north-south. This can most easily be done with a compass. If this is not available the building supervisor should stand on site with his arms stretched out and his left hand pointing to where the sun rises and his right hand pointing to where the sun sets. He will then be facing south and the verandah of the building should face in this direction. The roof overhangs of the building will then keep the sun off the long walls and windows for most of the day.

The building should then be roughly positioned on the site and pegs driven in at the four corners.

The area to be occupied by the building and an area all round at least 6'0" wide should be stripped of any top soil and vegetable matter and the soil piled up for future use. The extra space around the building will be required as workspace during construction.

All roots must be dug out and removed together with any termite nests found in the area of the building to prevent subsidence and termite attack later (fig.18).

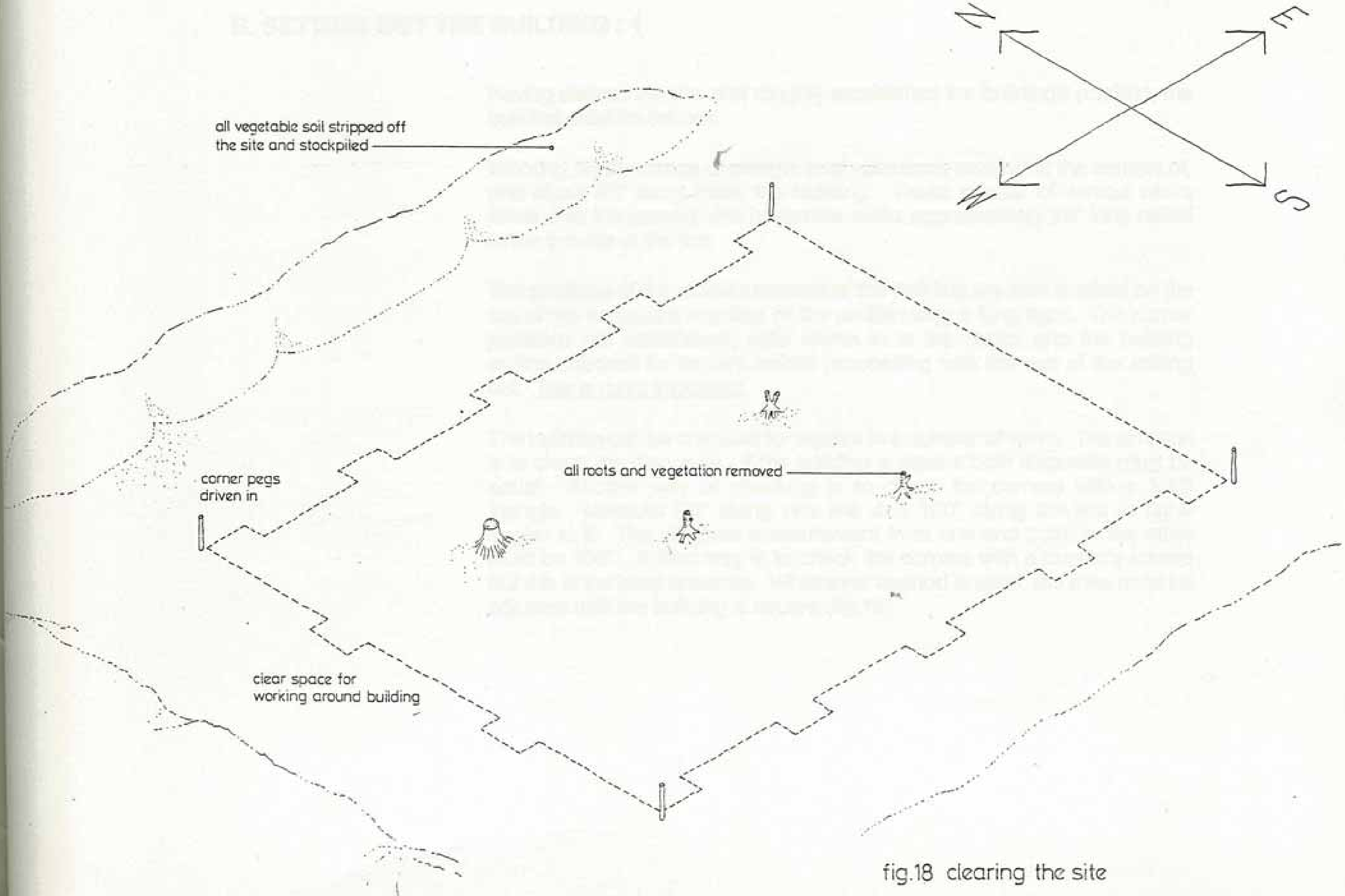


fig.18 clearing the site

B. SETTING OUT THE BUILDING : 1

Having cleared the site and roughly established the building's position, the building must be set out.

Wooden profiles made of straight bush-sticks are erected at the corners of, and about 3'0" away from, the building. These consist of vertical sticks driven into the ground with horizontal sticks approximately 5'0" long nailed to the outside at the top.

The positions of the outside corners of the building are then marked on the top of the horizontal member of the profile using a long tape. The corner positions are established, nails driven in at the marks and the building outline checked for square before proceeding with the rest of the setting out. <u>This is most important.</u>

The building can be checked for square in a number of ways. The simplest is to check the diagonals. If the building is square both diagonals <u>must</u> be equal. Another way of checking is to check the corners with a 3:4:5 triangle. Measure 9'0" along one line and 12'0" along the line at right-angles to it. The diagonal measurement from one end point to the other must be 15'0". A third way is to check the corners with a mason's square but this is the least accurate. Whichever method is used, the lines must be adjusted until the building is square (fig.19).

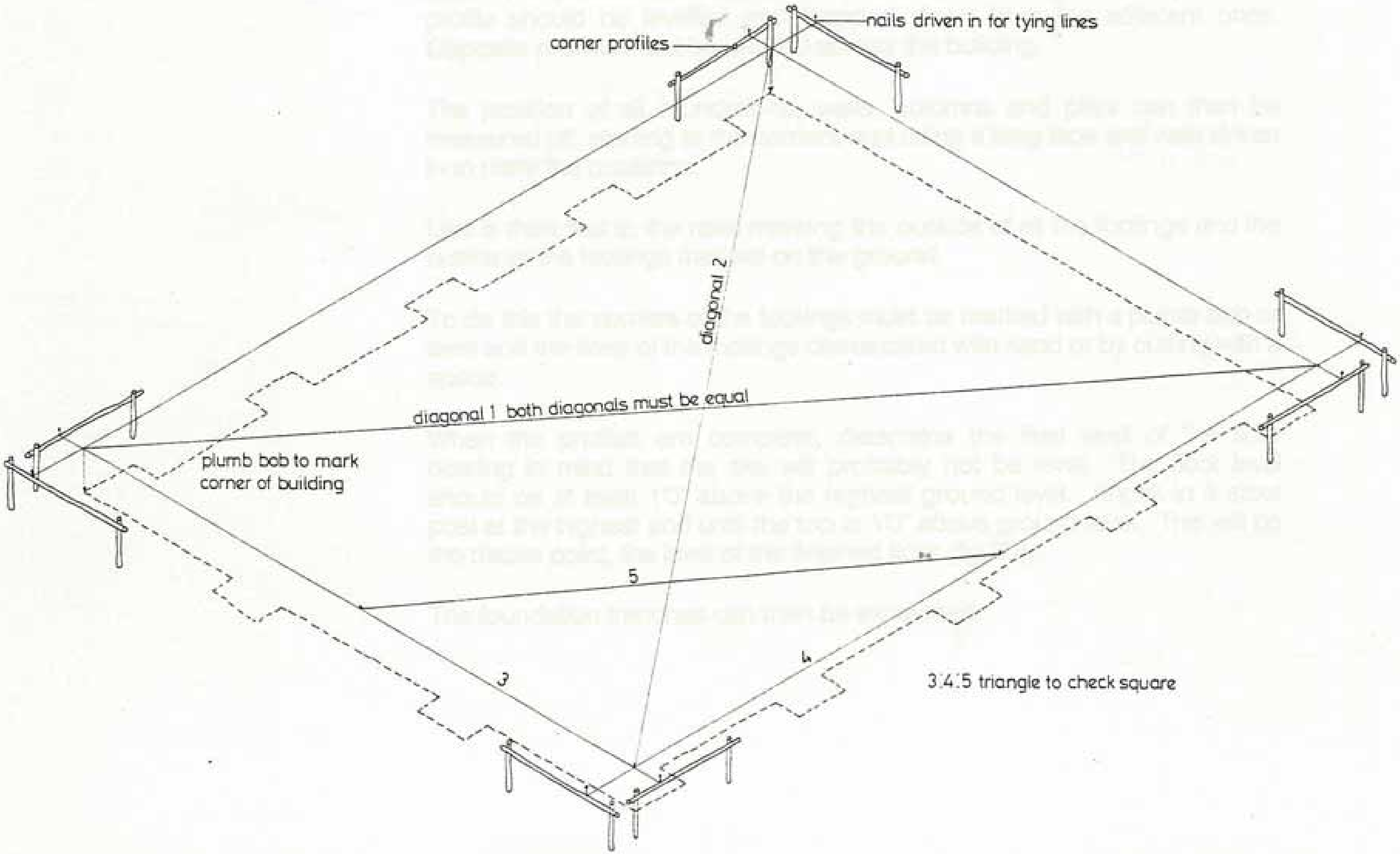


fig.19 setting out the building : 1

C. SETTING OUT THE BUILDING : 2

The remainder of the profiles can now be fixed. They are required wherever there are foundations, walls, columns or piers which will be built later. The profiles must be in line and level. If the ground slopes each profile should be levelled and stepped down from the adjacent ones. Opposite profiles must be levelled across the building.

The position of all foundations, walls, columns and piers can then be measured off, starting at the corners and using a long tape and nails driven in to mark the positions.

Line is then tied to the nails marking the outside of all the footings and the outline of the footings marked on the ground.

To do this the corners of the footings must be marked with a plumb bob or level and the lines of the footings demarcated with sand or by cutting with a spade.

When the profiles are complete, determine the final level of the floor bearing in mind that the site will probably not be level. The floor level should be at least 1'0" above the highest ground level. Knock in a stout post at the highest end until the top is 1'0" above ground level. This will be the datum point, the level of the finished floor (fig.20).

The foundation trenches can then be excavated.

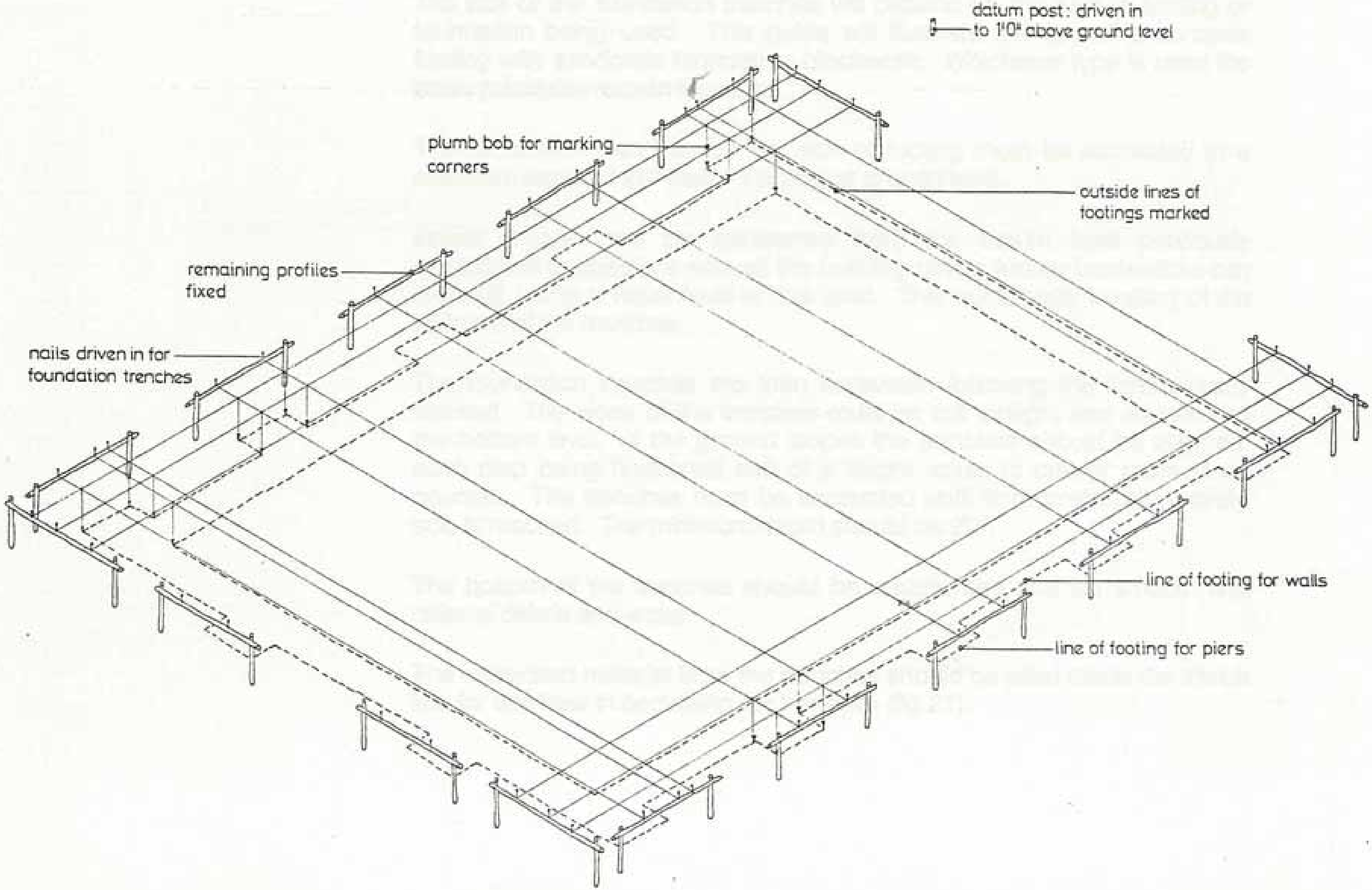


fig.20 setting out the building : 2

D. FOUNDATIONS : 1

The size of the foundation trenches will depend on the type of footing or foundation being used. This guide will illustrate the use of a concrete footing with sandcrete foundation blockwork. Whichever type is used the basic principles remain the same.

The foundation trenches for any sort of footing must be excavated to a minimum depth of 2'0" below the lowest ground level.

Levels should now be transferred from the datum level previously established to positions around the building where further bush-sticks can be fixed, using a water level or line level. This will simplify levelling of the bottoms of the trenches.

The foundation trenches are then excavated following the lines already marked. The sides of the trenches must be cut straight and square and the bottom level. If the ground slopes the trenches should be stepped, each step being horizontal and of a height equal to one or more block courses. The trenches must be excavated until firm, preferably gravelly soil, is reached. The minimum depth should be 2'0".

The bottom of the trenches should be undisturbed and left smooth and clear of debris and water.

The excavated material from the trenches should be piled inside the trench line for use later in backfilling the trenches (fig.21).

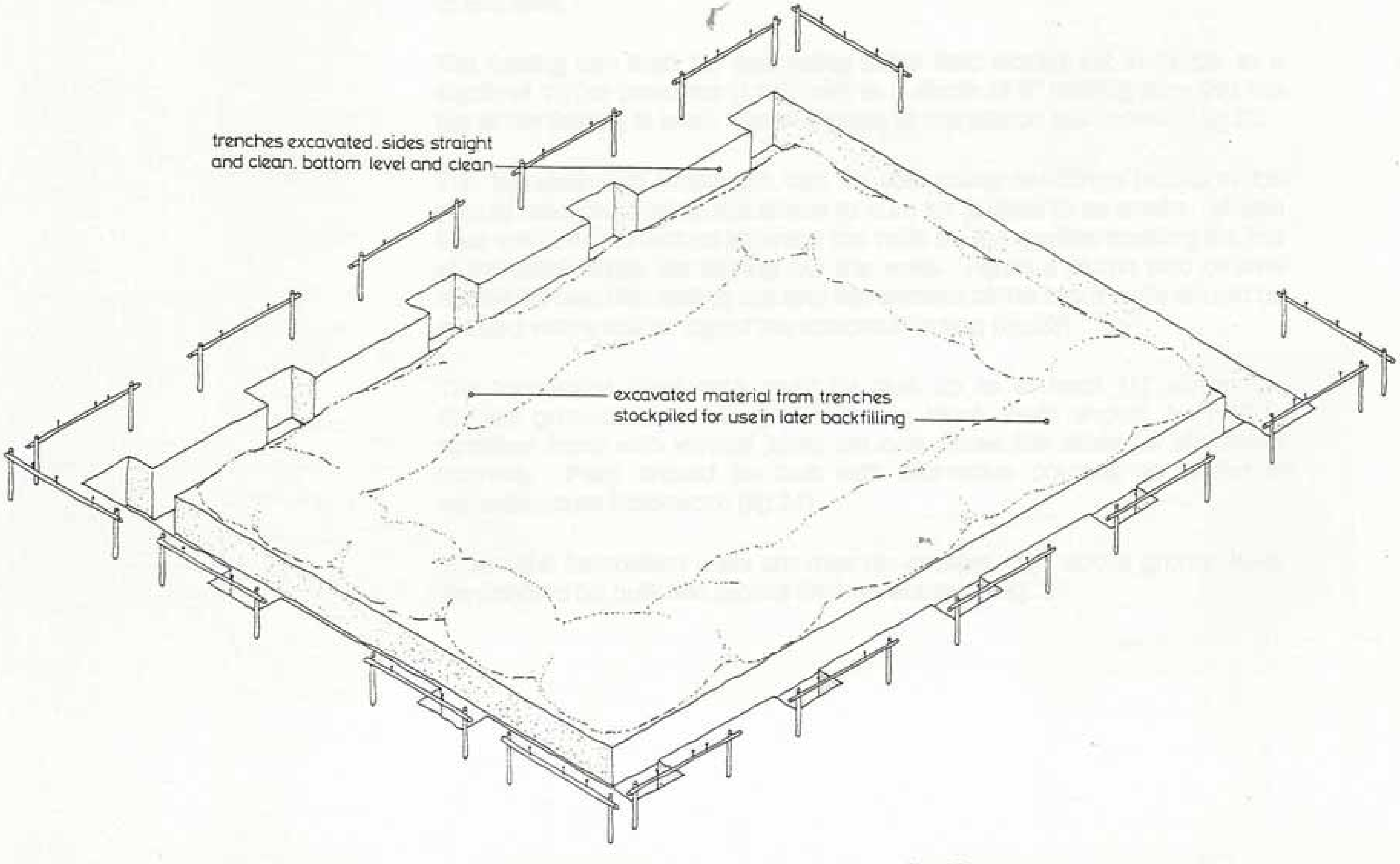


fig.21 excavating the foundation trenches

E. FOUNDATIONS : 2

Bush-sticks should now be driven into the bottom of the foundation trenches to a depth of 8" or 1'0" above the base and levelled using a water or line level.

The footing can then be cast using either field stones set in mortar to a depth of 1'0" or concrete (1:3:6 mix) to a depth of 8" making sure that the top of the footing is level. Various types of foundation are shown in fig.22.

The foundation of blockwork can be built using sandcrete blocks which should have been left in the shade to cure for at least three weeks. Mason lines are used, stretched between the nails on the profiles marking the line of the block walls, for setting out the walls. Again a plumb bob or level should be used for setting out and the corners of the block walls should be marked with a nail on top of the concrete footing (fig.23).

The foundation blockwork must be built up to at least 1'0" above the highest ground level. Single thickness block walls should be built in stretcher bond with vertical joints set one above the other on alternative courses. Piers should be built with alternative courses as shown in superstructure blockwork (fig.24).

Where the foundation walls are over six courses high above ground level, they should be built two blocks thick as shown in fig. 24

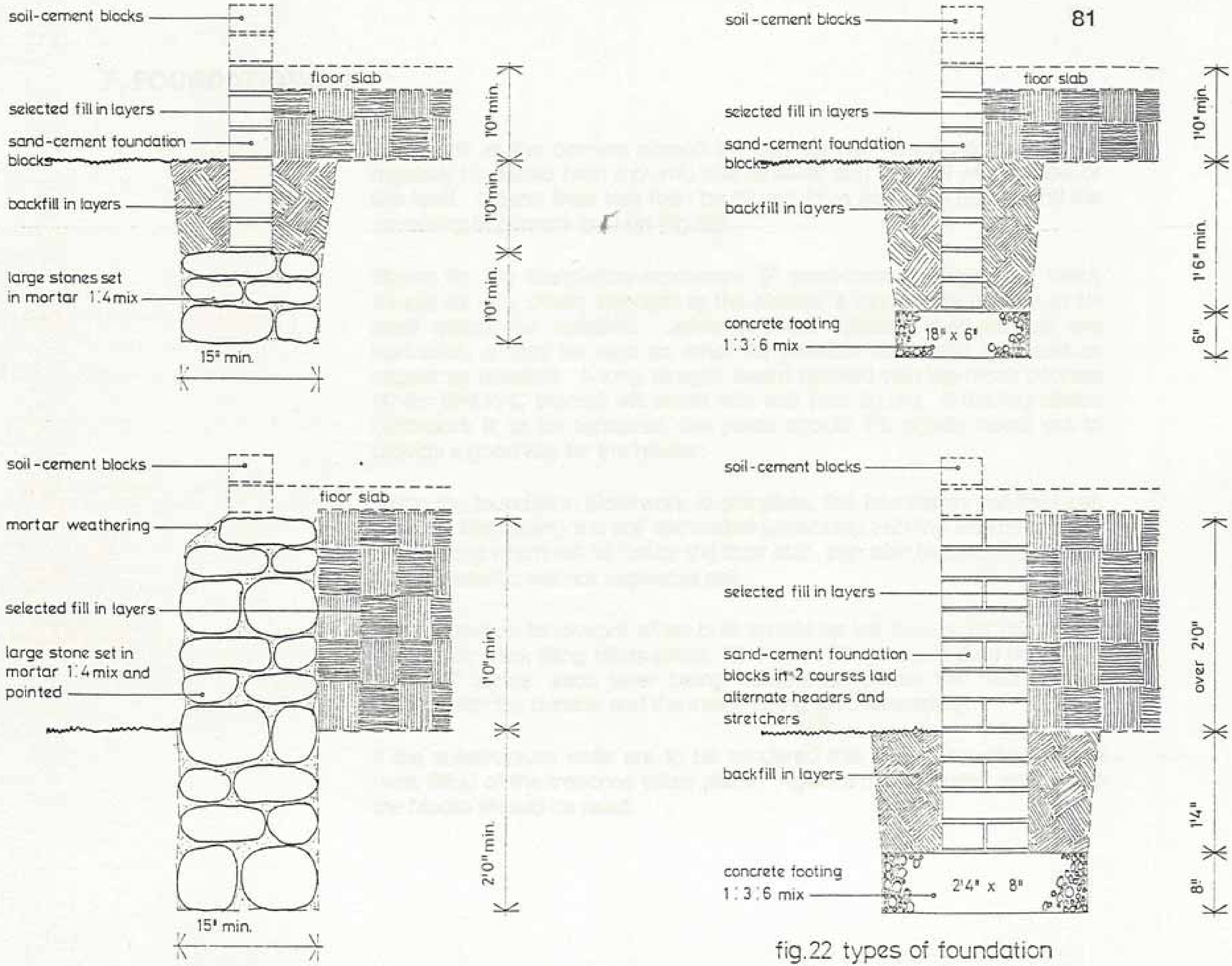


fig.22 types of foundation

F. FOUNDATIONS : 3

Blockwork at the corners should be built up first, checking the corners regularly for plumb (with a plumb bob or level) and for level with a water or line level. Mason lines can then be strung from corner to corner and the remaining blockwork built up (fig.23).

Mortar for the foundation blockwork (if sand-cement blocks are used) should be of a similar strength to the blocks; a mix of one cement to six sand should be suitable. Joints between blocks, both vertical and horizontal, should be kept as small as possible at around 1/2" and as regular as possible. A long straight board marked with the block courses (4" for BREPAC blocks) will assist with this (see fig.24). If the foundation blockwork is to be rendered, the joints should be slightly raked out to provide a good key for the render.

When the foundation blockwork is complete, the foundation trenches can be back filled using the soil excavated previously and the internal area of the building which will be under the floor slab, can also be back filled using suitable lateritic soil not vegetable soil.

The foundation blockwork when built should be left to cure for two weeks before any back filling takes place. The back filling should then be carried out in 6" layers, each layer being compacted before the next layer is placed, with the outside and the inside being filled alternately.

If the substructure walls are to be rendered this should be done before back filling of the trenches takes place. Again a mix of similar strength to the blocks should be used.

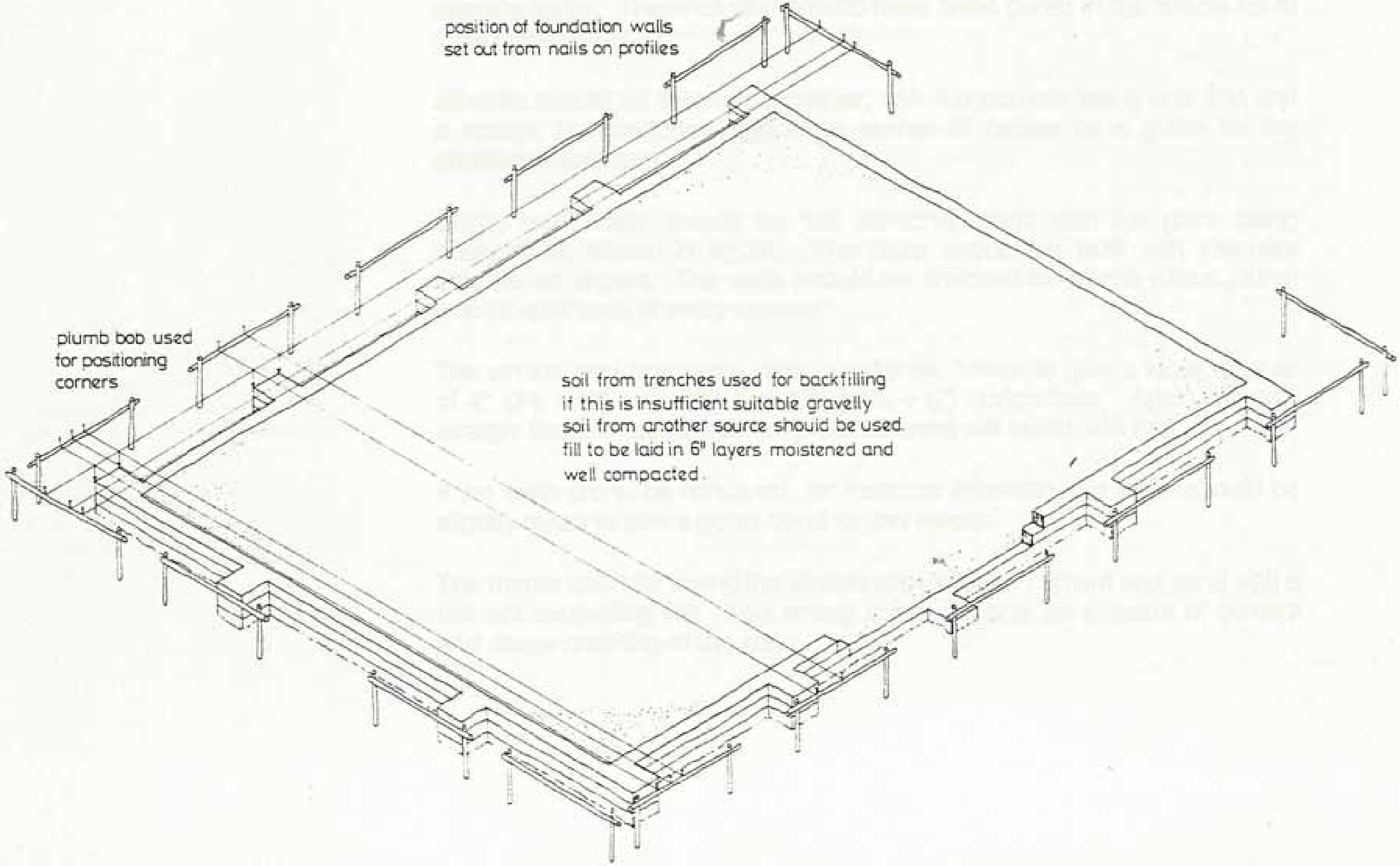


fig.23 foundation blockwork

G. SUPERSTRUCTURE WALLS

Upon completion of the foundation blockwork the superstructure blockwork can be started using the cement stabilized soil blocks previously manufactured. These blocks should have been cured in the shade for at least three weeks.

All walls should be taken up together, with the corners being built first and a mason line stretched tight from corner to corner as a guide for the blockwork between.

Single brick walls should be laid stretcher bond with the piers being coursed as shown in fig.24. The piers should be built with alternate courses as shown. The walls should be checked for plumb with a plumb bob or spirit level at every course.

The vertical and horizontal joints should be " thick to give a block course of 4" (3½" + ½") vertically and 12" (11½" + ½") horizontally. Again a long straight board marked with the block courses will assist with this.

If the walls are to be rendered, for instance internally, the joints should be slightly raked to give a good bond for the render.

The mortar used for laying the blocks should be of cement and sand with a mix not exceeding 1:8. Too strong a mix will only be a waste of cement and cause cracking of the walls.

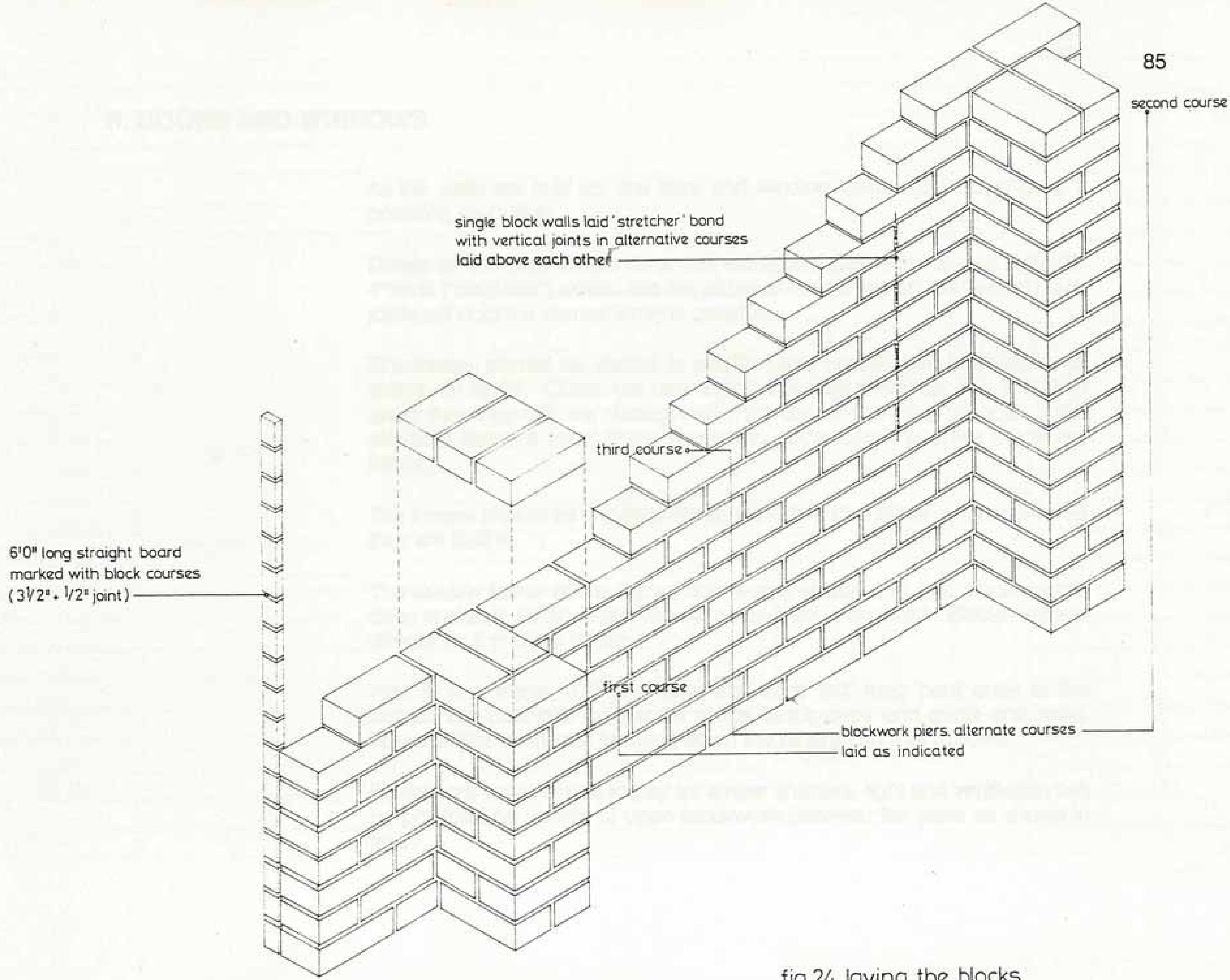


fig.24 laying the blocks

H. DOORS AND WINDOWS

As the walls are built up, the door and window frames (if used) should, if possible, be built in.

Details of standard timber door and window shutters are shown in fig.25. 4" nails ("hold-fast") driven into the sides of the frames on the lines of block joints will hold the frames firmly in position.

The frames should be placed in position and braced with bush-sticks as shown on fig.26. Check the height of the bottom of the window frames in order that they will line through with the top of the door frames. If the standard frame is used there should be seven block courses below the frame.

The frames should be checked for plumb with a plumb bob or spirit level as they are built in.

The double frame at the top of doors and windows is one block course deep and acts as the lintel. No concrete lintel is required. Blocks are laid directly on top of the frame.

Also at this stage, 3/8" diameter iron rods 5'0" long bent once at the bottom are built into the centre of the block piers and gable end walls. These will be used later for tying down the rafters and roof trusses.

If funds are not available to pay for timber shutters, light and ventilation can be provided by panels of open blockwork between the piers as shown in fig.27.

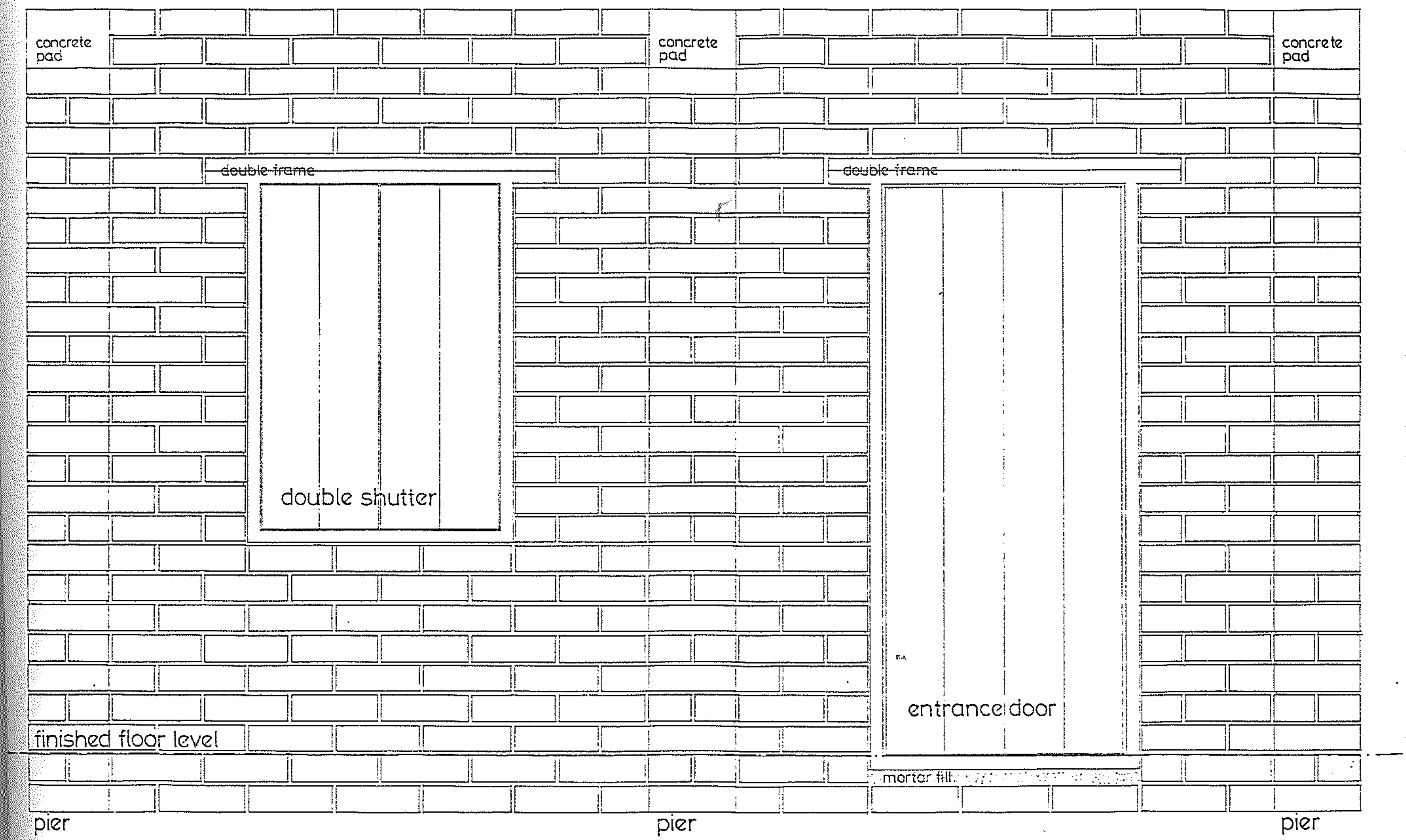


fig.25 typical wall panels : door and shutter

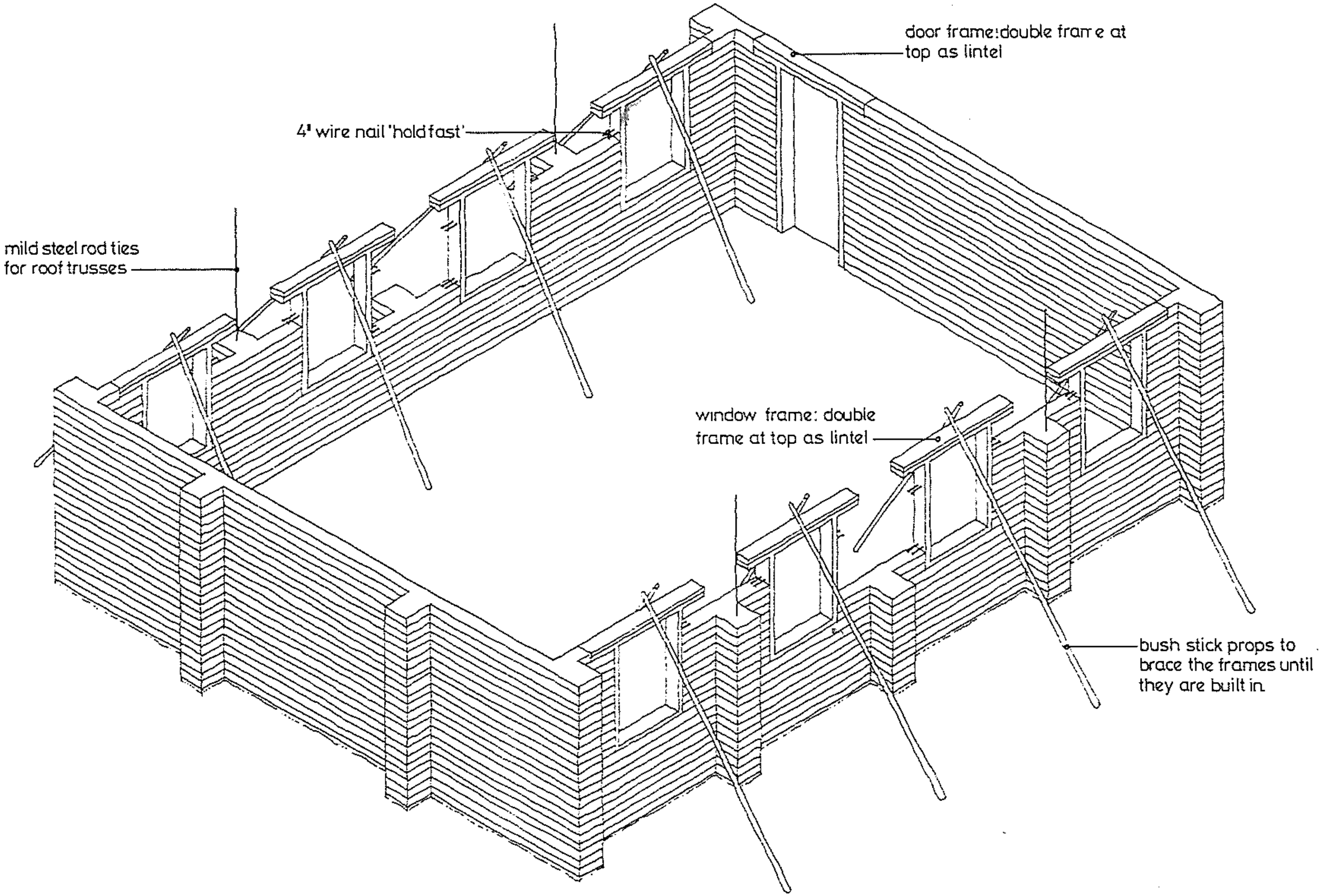


fig.26 fixing the door and window frames

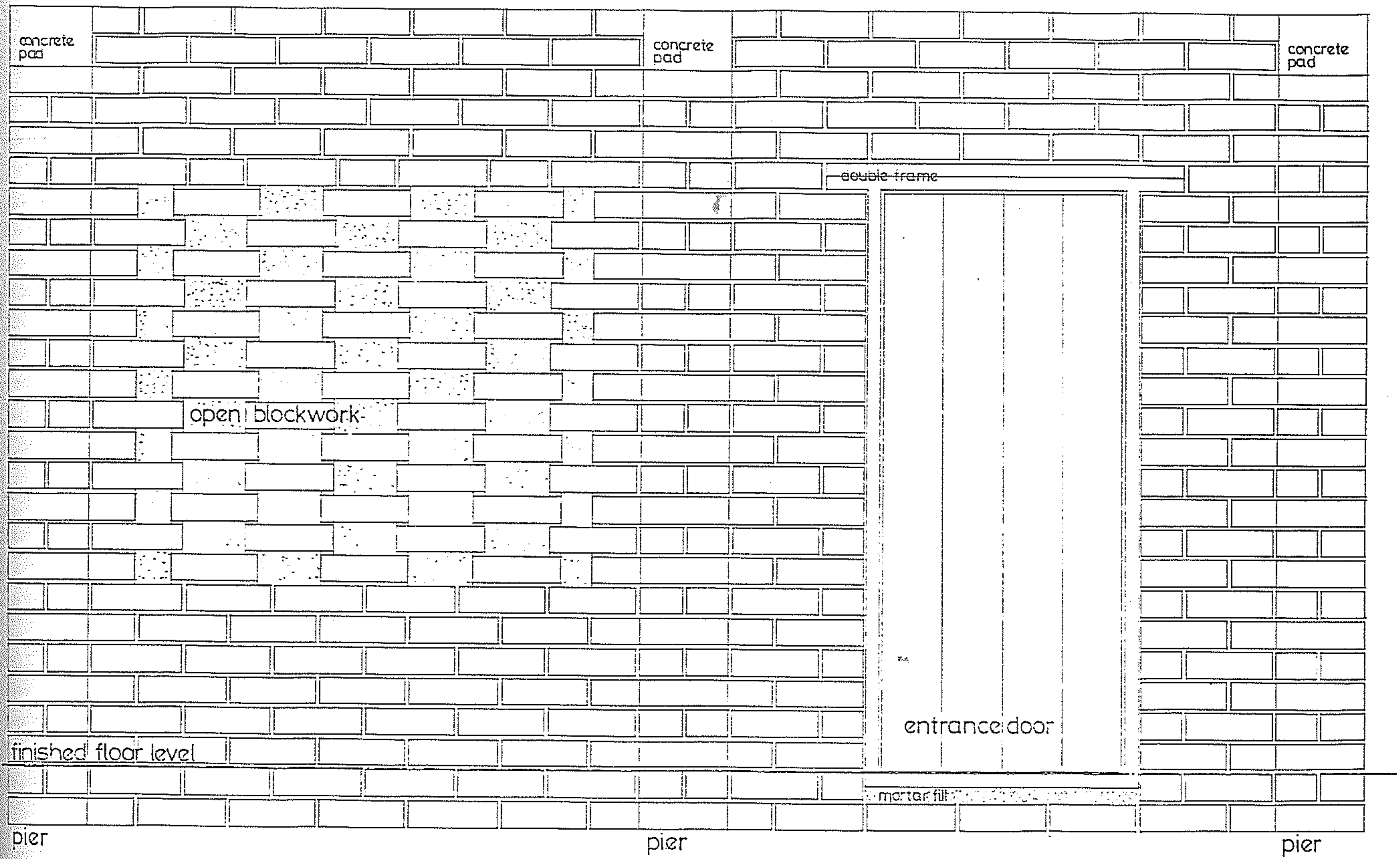


fig.27 typical wall panel: open blockwork

I. GABLE END WALLS AND RAFTERS

The gable end walls are built up to a level 25 courses, (8'0") above finished floor level. Straight boards are fixed outside the end piers and nails driven 8'4" above floor level. Another board (approx. 15'0" long) is positioned in the centre of the gable end wall and a nail driven in 13'4" above floor level. Lines are then tied from the centre nail to the outside nails. This gives the line of the top of the gable wall (fig.28).

Mass concrete pads are cast on top of the two outside piers with the top of the pad following the sloping line of the gable wall. This gives support to the cantilevered rafter, and the blockwork is then carried up to the line. The top of the walls should be levelled with mortar to follow the line accurately.

4" bush-stick rafters approximately 15'0" long, straightened and cut square as necessary, are then placed on top of the gable walls and tied down by bending the ends of the 3/8" m.s. rods previously built in over them and nailing them down.

The intermediate piers are built up to a level 7'4" (22 courses) above floor level.

Mass concrete pads 8" deep are cast on top of the intermediate piers leaving the 3/8" rods protruding in the centre. These will provide support for the roof trusses.

The walls between the piers are built up to line through with the top of the piers.

All roof timbers should be treated with a preservative if possible. Burnt engine oil is the cheapest, least toxic and most easily obtained. It should be applied liberally with a brush to all surfaces of the rafters, trusses and purlins, preferably before building them in.

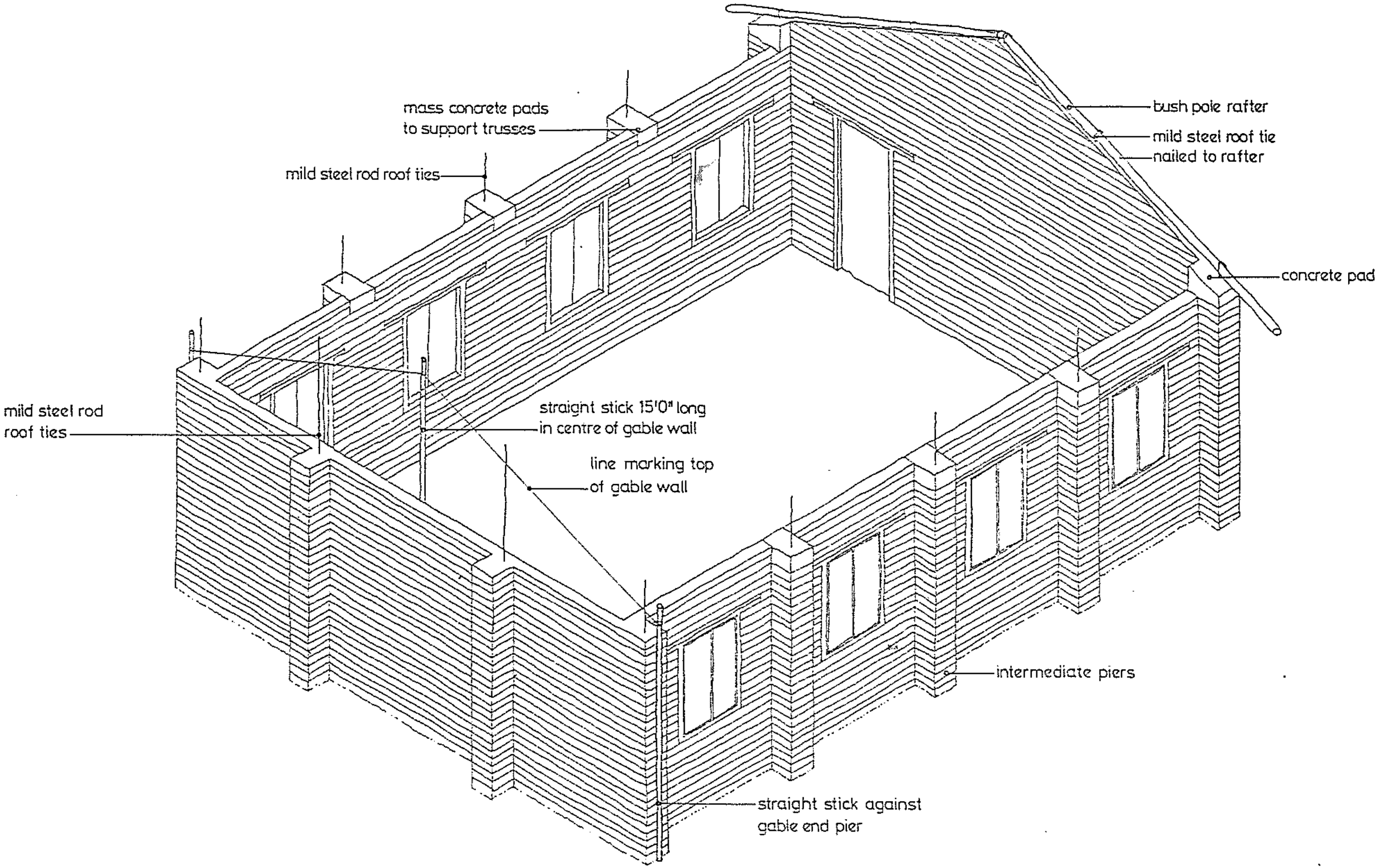


fig.28 gable end walls and rafters

J. ROOF TRUSSES

Lines are tied from the rafters at each end of the building at the top, bottom and in the middle and the trusses are then erected. Details of typical trusses are given in fig.30.

Lines are tied across the building from pier to pier and 4" nominal bush-sticks erected centrally on the centre line of each pier. They should be higher than the centre of the gable and will be trimmed later (fig.29)

The two top members of each truss are erected to follow the lines tied to the end rafters and then nailed to the central member. The lower members are then erected, the bottom end going underneath the top member over the pier, the top end being nailed to the opposite top member and the central member.

The struts are then fixed, having first established the positions of the purlins.

Two gusset plates of 1" boards on top of each pier are nailed to either side of the truss and the 3/8" holding down bar bent over and nail fixed. These plates provide bearing for the truss and stiffen it.

The central members can then be trimmed at the top and cut off below the cross members.

Fixings can simply be of 3" and 4" wire nails, care being taken not to split the poles. A better solution would be to bend sheet metal strips (cut from old car bodies) around the double members and nail fixed.

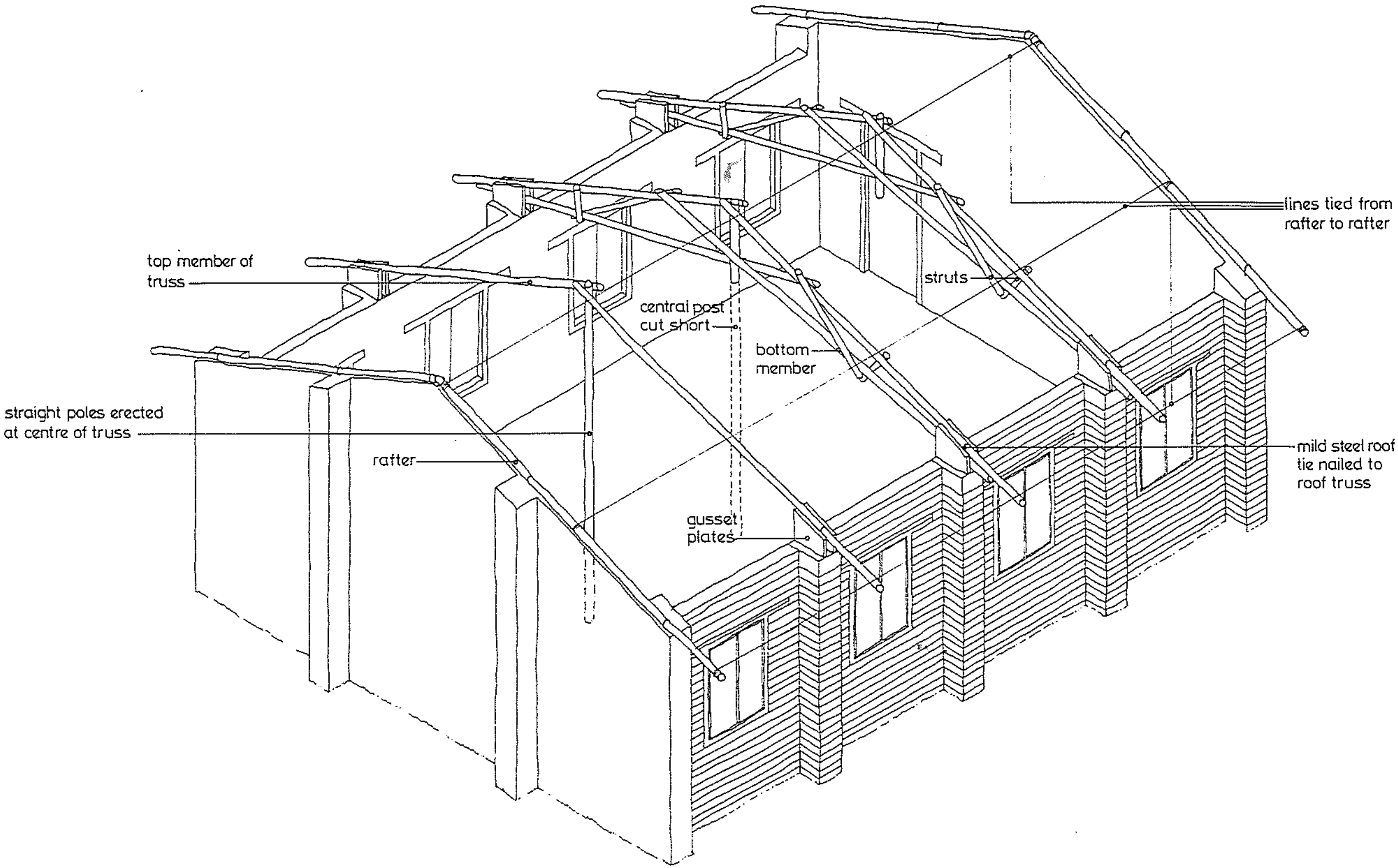
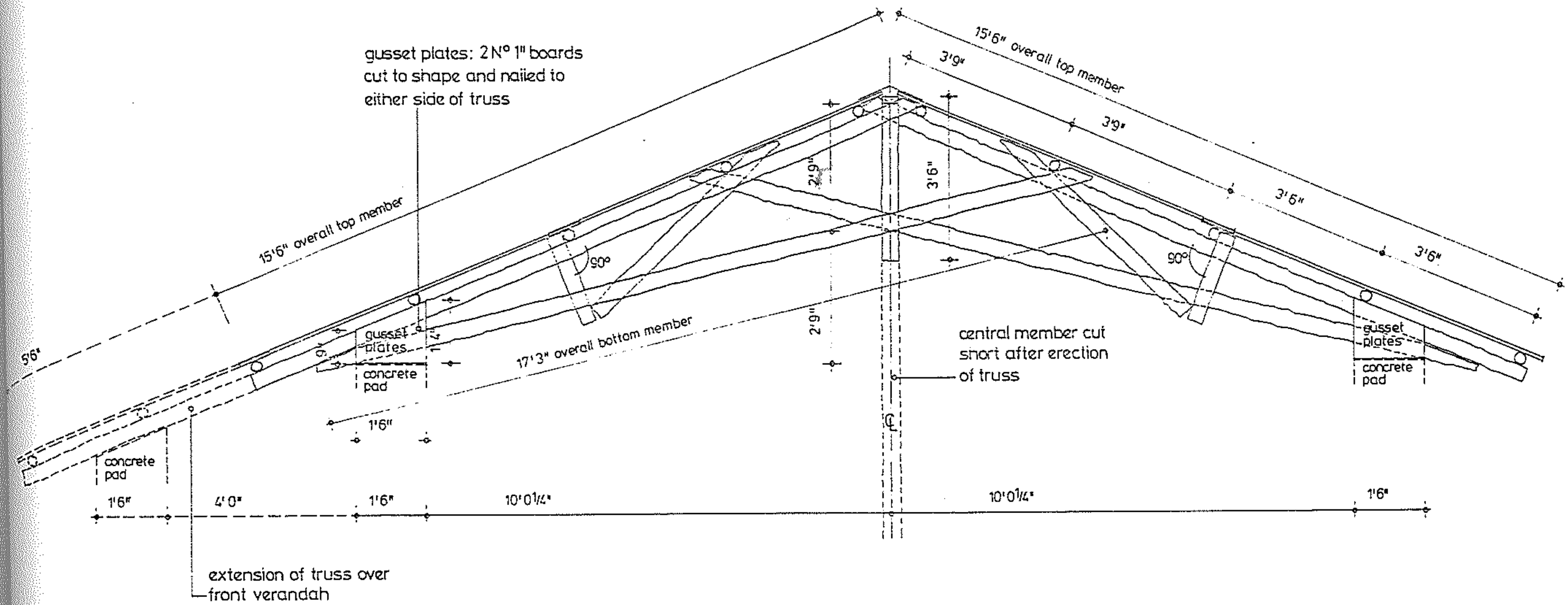
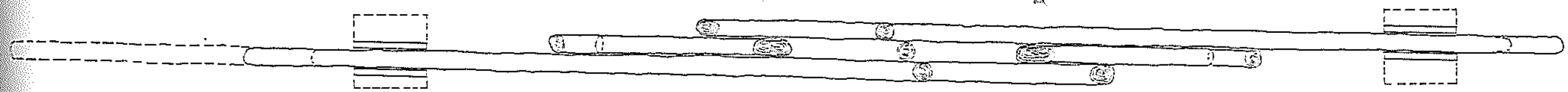


fig.29 erection of roof trusses



ELEVATION



PLAN OF TRUSS

all truss members of 4" nominal
bush poles. all joints nailed or
wrapped in strip metal and nailed

fig. 30 details of bush pole truss

K. ROOF PURLINS

Nails are fixed to the rafters on the two end walls marking the positions of the purlins and lines tied between them. Each roof sheet has a purlin under each end and one in the middle.

3" diameter bush-stick purlins, as straight as possible and trimmed if necessary on the top surface, are then laid along the lines previously fixed and nailed to the rafters and trusses. At least 2'0" overhang at each end must be provided.

The top and bottom purlins should be fixed first and two diagonal lines are then tied corner to corner to check that the roof is straight, flat and level. The lines should just touch in the middle. If they do not, then the purlins must be adjusted.

When all the purlins are in position, the roof covering can be fixed. The following procedure is for the commonest roof covering, galvanised, corrugated steel sheets.

First the direction of the prevailing wind in the rainy season should be established. The roof sheets should be laid into the wind to minimise the possibility of rain being blown under the joints. The prevailing wind is usually from the south west or west, thus the first roof sheets should be laid at the east end of the building.

Before fixing the sheets a straight board must be fixed to the two lowest purlins at each end of the building and a line tied between parallel to the face of the building which marks the lower edge of the roof. At the east end a line is taken up to the ridge at right angles to the lower line. This marks the line of the east verge against which the first sheets should be laid (fig.31).

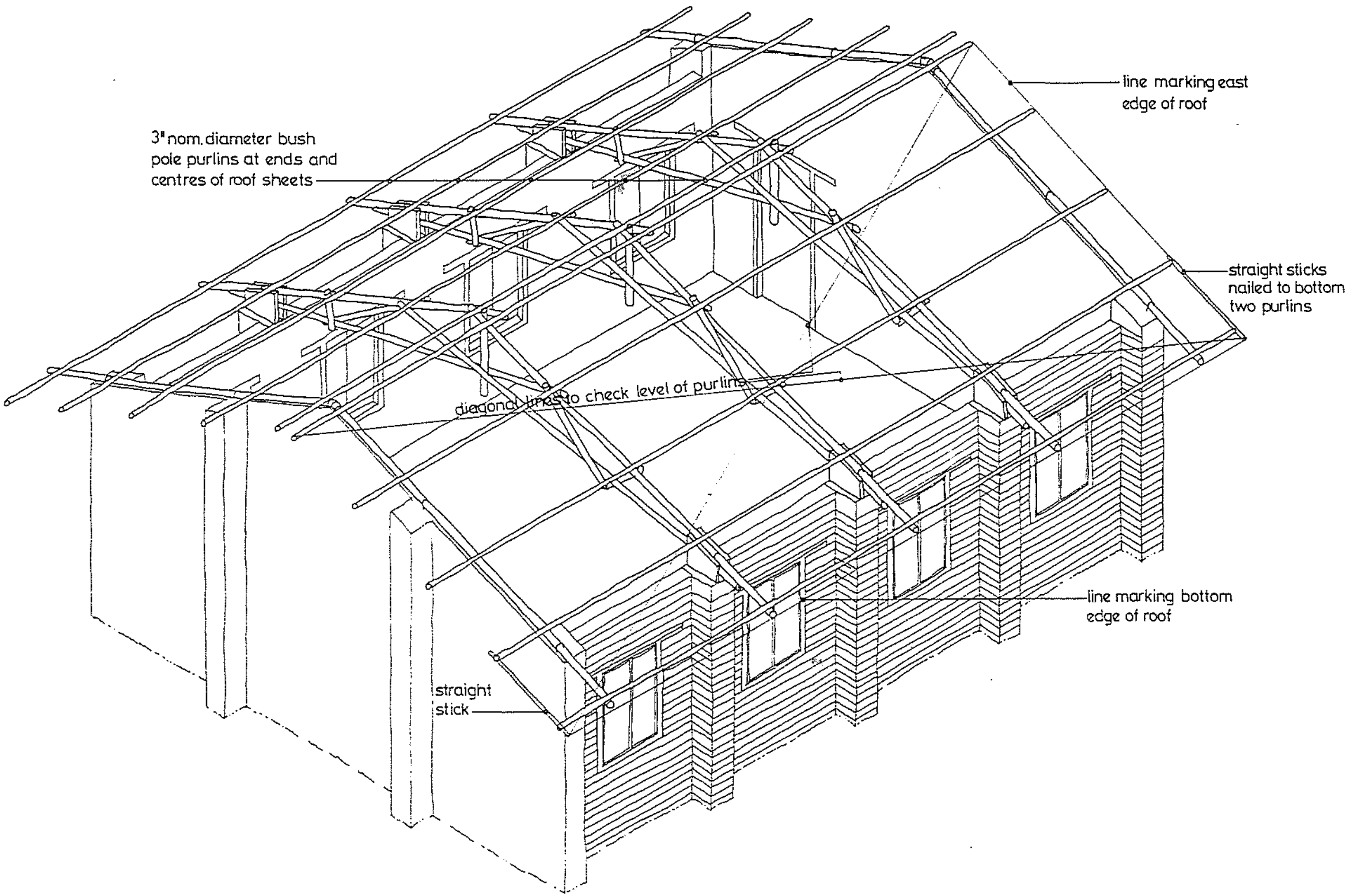


fig.31 fixing the roof purlins

L. ROOF COVERING

Care must be taken that side and end laps are correct in order to reduce the likelihood of leaks.

The building illustrated has two eight foot sheets on each side laid with a 9" end lap, the top sheet over the lower sheet (fig.32)

If the sheets are ten or twelve corrugations wide the sheets should be laid with two corrugations side lap; if they are 10½or 12½corrugations wide they should be laid with 1½corrugations side lap.

Check the number of roof sheets to be used to provide at least 2'0" overhang at each end of the building and then having established the exact overhang, the first, lower sheet at the east end can be fixed, making sure that the bottom edge and the east edge are parallel to the two lines previously fixed.

Fixing the sheets can then proceed, the bottom sheet in each line being fixed first. It is useful to have one man on the ground sighting the sheets to make sure they are in line before fixing. All fixings must be through the top of the corrugations.

When both sides of the building are roofed, the ridge piece can be fixed, again starting at the east end. If the ridge pieces can be rivetted to the sheets rather than nailed a more water tight finish will be achieved.

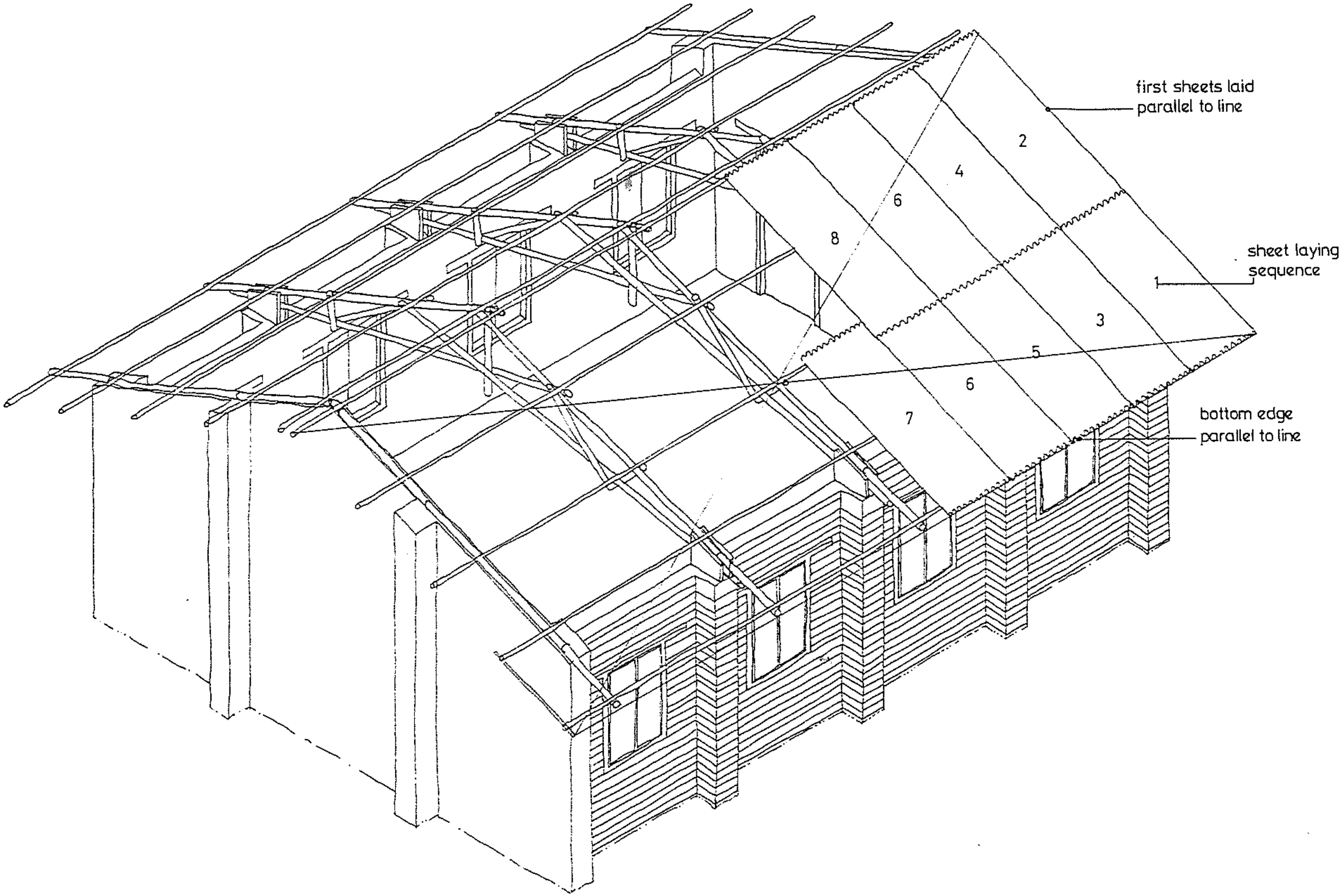


fig.32 fixing the roof sheets

M. FLOOR SLAB

Having built the walls and roofed the building, the floor can be constructed. A hard wearing, non-dusting floor is essential; one that will stand up to the hard wear inflicted by school children and school furniture.

The soil inside the building should by now be well consolidated, but must be brought up to the correct level, at least 1'0" above the outside ground level at its highest point.

If additional fill is required it should be gravelly soil, not vegetable top soil. The top soil should be cleared off at a convenient place and the gravel soil dug out. It should be spread in layers of a maximum thickness of 9", wetted and well beaten with the ends of stout bush poles until it is firm.

If field stones are available a layer of these, 9" thick can be laid on top of the soil fill and well rammed. This open stone layer will stop moisture rising up into the floor slab. Spread a layer of sand on top of the stone before casting the slab.

If a concrete floor slab is being constructed this is then cast on top of the fill. The mix should be one cement, three sand and six stones, or one bag of cement to six headpans of sand to twelve headpans of stones (1 bag of cement will fill two headpans). The stones should not be very large, around 3/4" maximum, and the sand should be coarse river sand if possible, not fine pit sand. It is important not to use too much water even though this makes mixing easier. It will reduce the strength of the concrete.

Do not try and mix and lay too much concrete in one day. Unless a great many people are available to do the work, half a classroom a day will be sufficient. Put a straight board across the centre of the classroom and lay the concrete up to it. The next day remove the board and lay the other half. The slab must be finished smooth and level with a steel trowel and it must be properly cured. To do this it must be kept moist for two weeks by watering twice every day and if possible covering with sand. If it dries out too soon this will again reduce its strength.

The verandah slab, if any, can be laid the same way. If it is a front verandah it should be 6" lower than the classroom floor and slope 1" from the back to the front. If it is an inset verandah it should slope 1" down from the entrance door to the front.

An alternative floor finish is the sandcrete tile produced on the Parry Associates tile machine. This has the advantage of not requiring stone and will provide a good wearing surface. If tiles are used the fill under them must be properly levelled and well consolidated; if possible a polythene damp proof layer should be laid on a thin sand bed; the tiles are then laid on a 3/4" cement sand mortar bed (1:6 mix) and the joints pointed. Again the floor must be properly cured before use.

N. FINISHES:

RENDER

If BREPAC blocks are used and they are laid neatly it will be unnecessary to render the external walls apart from the cable ends. These are exposed to the rain and must be rendered.

If funds are available the walls should be rendered internally, which will give a smooth inside surface which can more easily be kept clean and painted. If funds are limited it is more important for the protection of the building to render the gable end walls than the inside walls. These latter can be finished with flush joints and painted with a cement wash. Any external block columns along verandahs should also be rendered. The mix for the render should not be too strong. If it is stronger than the blocks of which the wall is built the render will eventually crack. The best mix for the render is therefore probably one cement to eight sand (1 bag cement to 16 headpans of sand). The sand should preferably be fine and smooth. Pit sand, if it does not contain clay, will be ideal. The render should be applied in one coat, ½" thick. The walls should ideally be wetted before rendering starts.

CEILINGS

For reasons of comfort a ceiling of some kind should be fixed if at all possible. This will reduce the amount of heat transmitted from the roof sheets and thus keep the classrooms cooler.

The easiest way to fix a ceiling of whatever sort, is to nail it directly to the underside of the roof purlins, leaving the roof trusses exposed. The high ceiling will make the classrooms feel more comfortable and will be cheaper to fix.

The best sort of ceiling, if funds are available is one made of softboard (celotex) sheets. This will provide the best insulation. However, if this is not available, hardboard or local mats provide possible alternatives. Any ceiling will help reduce the temperature inside the classroom and also reduce the noise from the roof during rain.

CHALKBOARD AND PINBOARDS

The simplest way to provide chalkboards is to finish panels of render, starting 3'0" from the floor and going up to a height of 7'0", with a steel float to a very smooth finish. The panels of render should then be painted with chalkboard paint.

Pinboards should be provided if possible of 4'0" x 8'0" sheets of softboard, nailed or glued to the wall. An alternative to pinboards are tacks-strips, 2" x ½" timber strips nailed to the wall to which posters, drawings, paintings etc. can be pinned.

SHELVES

Shelves can be provided in the classrooms for display purposes and in the store. These can be simply constructed of 2" x 2" uprights, steel nailed or screwed to the wall to a height of say 7'0" with triangular supports nailed to one side, supporting 1" x 10" boards planed and sanded, as shelves. In the classrooms shelves can be fixed between the piers on the end walls.

O. EXTERNAL WORKS:

DRAINS

It is most important that storm drains are provided to both sides of the building under the edge of the roof. The top of the drain should be at least 12" below the top of the floor. The ground should slope away from the building to the top of the drain.

The drain can simply be an unlined earth drain or can be lined with field stones laid on mortar. The drain m ust slope from one end of the building to the other and then be led away from the building. It is important that the slope is even in order that pools do not form where mosquitos can breed. The slope should be at least 1 in 100.

PAVING

If possible, the ground along the gable end walls should be paved with field stones set in mortar to a width of 2'0". The paving should slope away from the building. This will protect the end walls from erosion (fig.33).

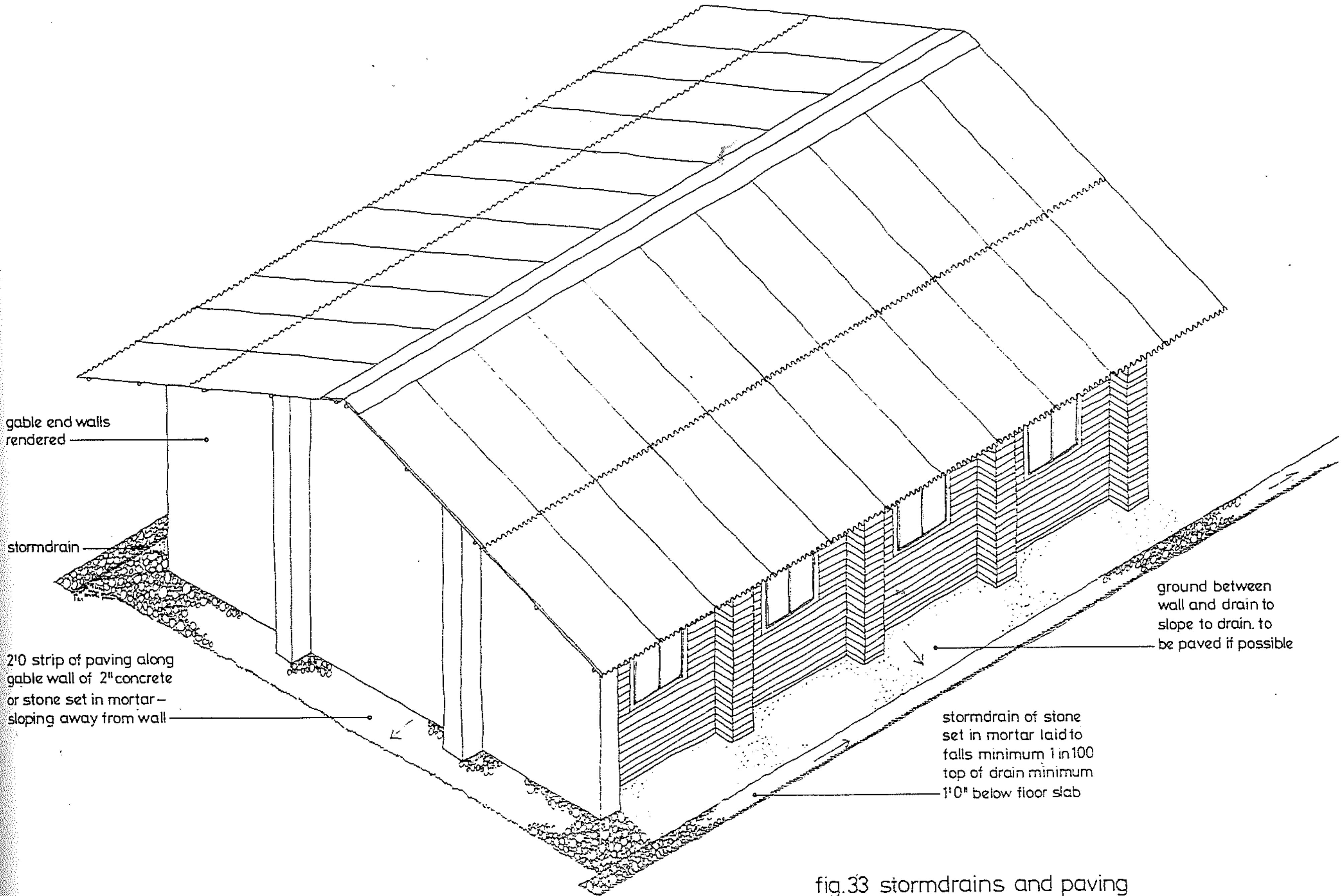


fig.33 stormdrains and paving

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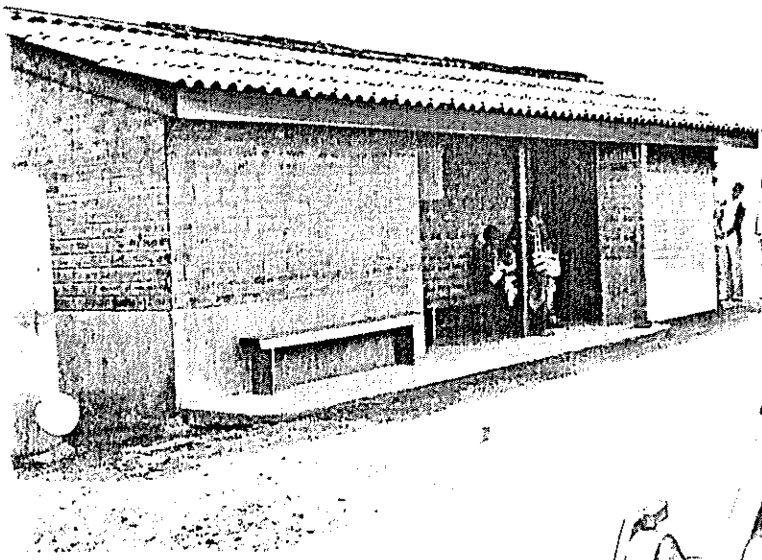
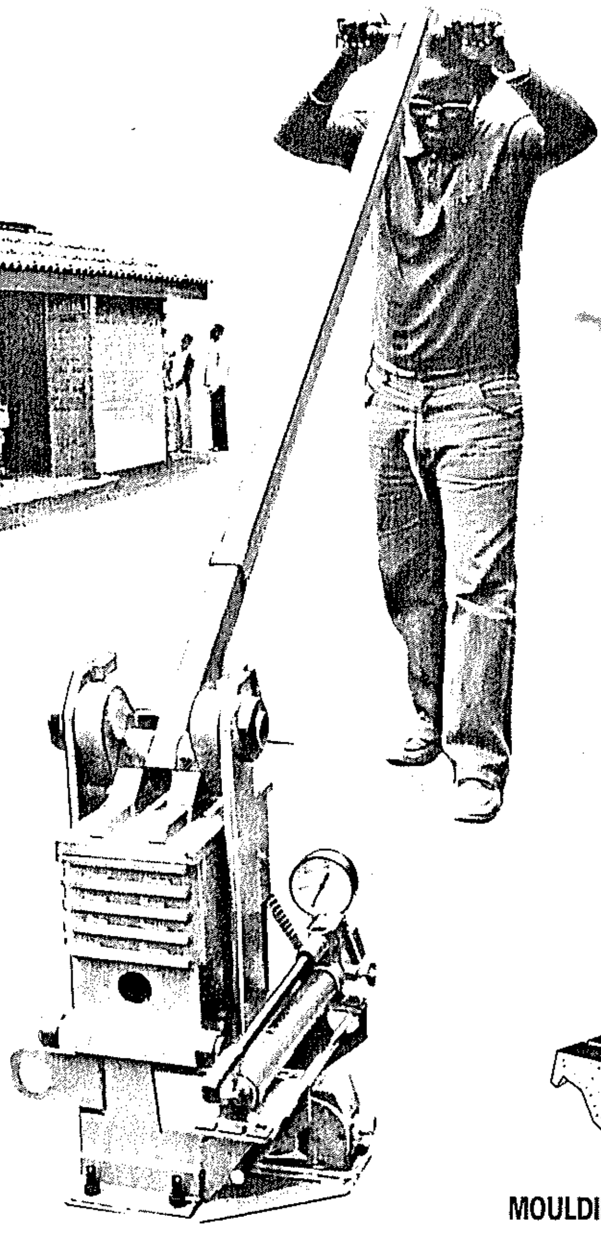
ANNEXE 1

THE MULTIBLOC BREPAK BLOCK PRESS

1. Producing low cost quality building blocks from stabilised soil.
2. Simple to operate with minimal maintenance required.
3. Compact and easy to move from site to site.
4. Ideal for use in remote areas. No power required.



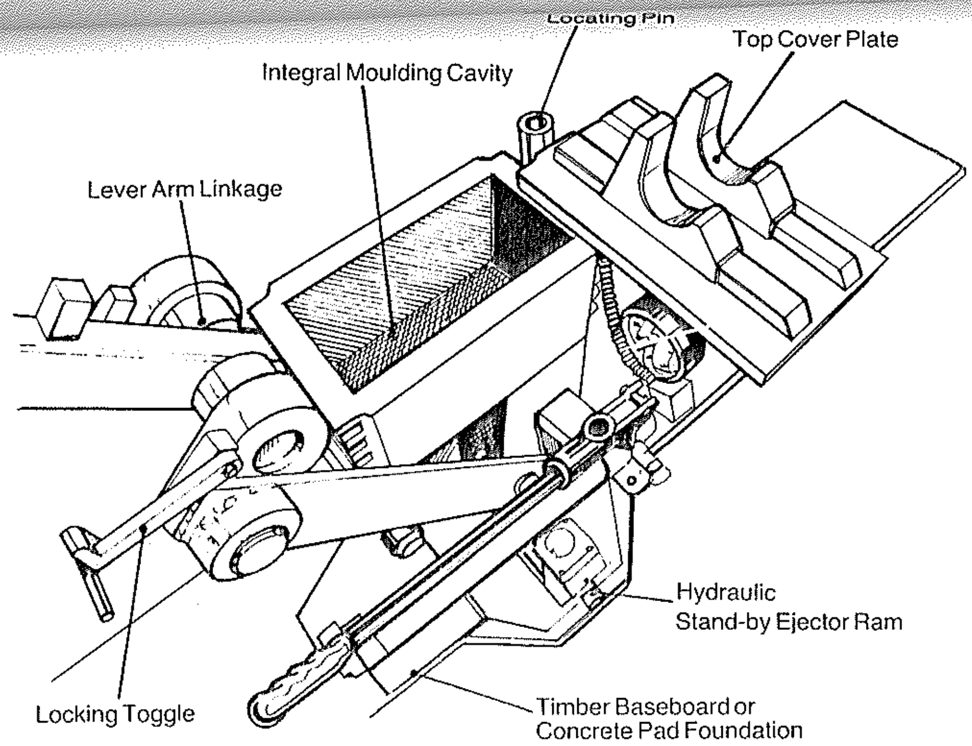
Clinic built at Kabiro, Kenya with 'Brepak' Soil Blocks



MULTIBLOC

MOULDING AROUND THE WORLD

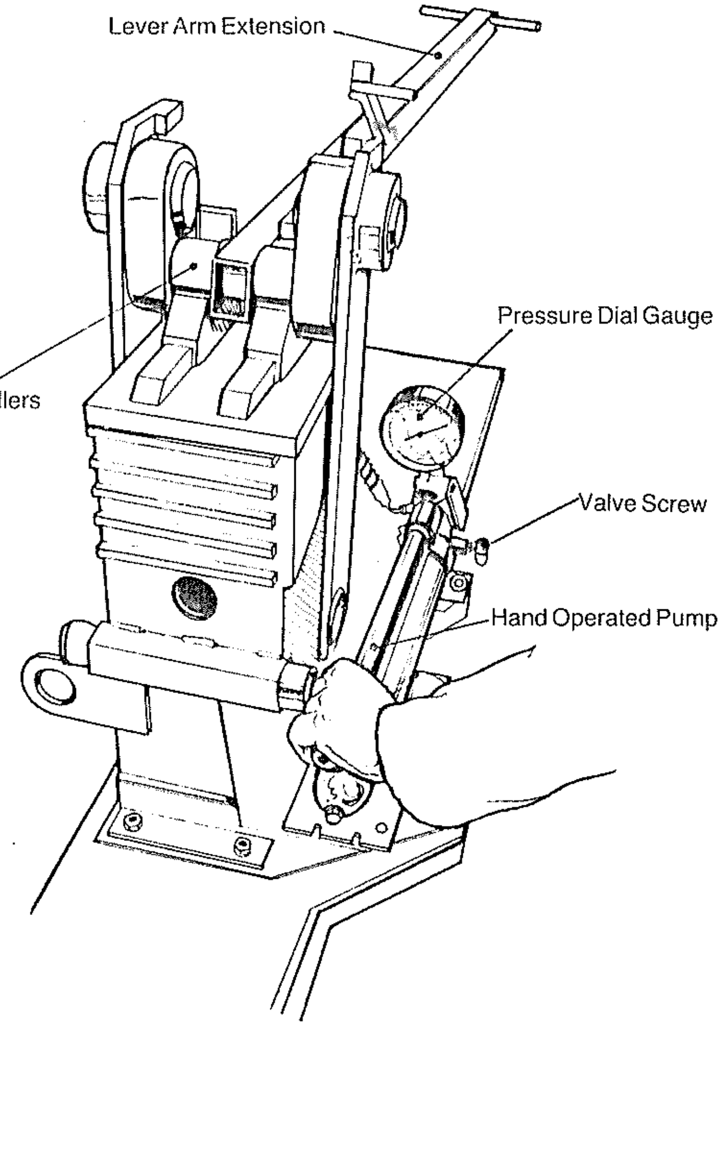
THE MULTIBLOC BREPAK BLOCK PRESS



The Multibloc Brepak machine comprises a moulding area of fixed size which, together with the supporting structural frame, forms an integral unit of an all-steel construction. The complete unit should be mounted to a permanent foundation or may be used on a rigid timber baseboard.

Access to the mould area is via a top cover plate pivoting about a corner mounted locating pin, the cover plate may be moved to one side away from the mould opening. The compact design of the unit allows for ease of installation at site and may be used from site to site when mounted to the timber base.

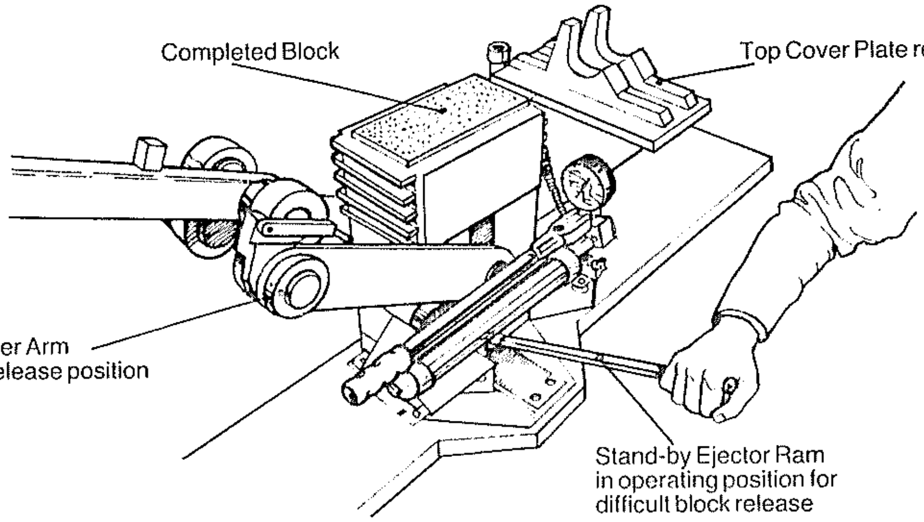
The machine design and manufacture is specifically in keeping with the requirements for long service life with a minimum of spare parts useage and maintenance making the unit particularly suitable for use in areas where rural development is of primary importance.



The press is fitted with a lever arm extension and mechanical linkage which provides a means of locking the top cover plate onto the mould and also allows for initial compaction of the block material within the mould area.

The Brepak block press was developed by the Overseas Division of the UK Building Research Establishment and is being manufactured under licenced granted by this Establishment.

Once the lever arm and cover plate are secured the second stage of block compaction, up to a pressure of 10 MN/m^2 is applied by use of the hand operated hydraulic pump acting through a piston beneath the base plate of the mould.



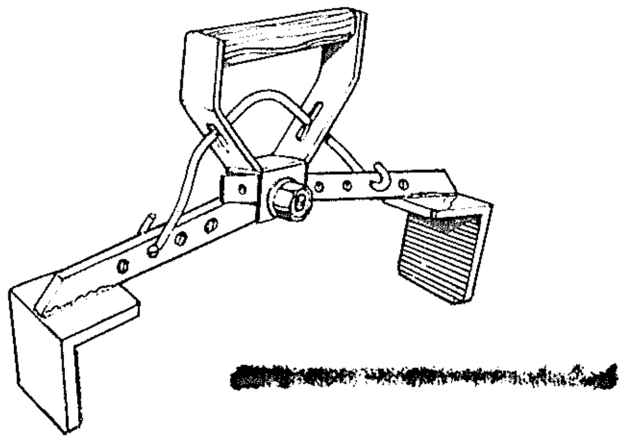
Production Sequence

1. The top cover plate is moved to one side on the locating pivot to gain access to the moulding cavity, it should be ensured that the ejector ram is clear from beneath the base plate of the mould.
2. With the base plate in its lowest position within the mould the screw valve of the hydraulic pump is unscrewed by one turn. The internal surfaces of the mould area should be lightly oiled to aid the release of new blocks.
3. The mould is then manually filled with a measured quantity of the soil mixture and hand pressure is used to ensure complete filling of the mould corners. Once completely filled the top cover plate is moved across the top to its closed position.
4. The lever arm is fitted with a locking toggle which now placed in the locking position, the lever arm assembly may now be raised by approximately 90 degrees until the centre rollers enter the guide locations on the top of the mould cover. At this point the lock toggle is returned to its original position and the lever arm is pulled downward through a further 90 degrees to a horizontal.
5. The screw valve is tightened by hand pressure so that the pump may be manually operated and the mould base plate pushed up into the mould cavity by the piston. The pump is operated until a dial gauge reading of 8,000 lbs./sq. ins. is reached, this ensures complete compaction of the block.
6. By release of the screw valve the hydraulic pressure on the piston is released so that the lever arm may be returned through a full arc back to its original position.
7. The newly pressed block is exposed by sliding the top cover plate to one side and downward pressure on the lever arm will eject the block for removal. If significant resistance is felt the stand-by ejector ram is put beneath the mould base plate and operated until the block is free.

THE MULTIBLOC
BREPAK BLOCK CLAMP

When securely gripped between rubber pads this simple, hand-held clamp permits the easy movement and accurate placing of cured blocks.

Block handling around the site and during laying is reduced to a single-handed operation and results in fewer breakage losses with improved productivity.



Soil Selection

Not all soil types are suitable for block production however 'Lateritic' soils with a clay content as found in the tropical and semi-tropical regions of the world will generally be acceptable. It is the clay content of a soil that is most susceptible to the action of weathering and which will shrink and swell with the addition of water.

This type of soil may be stabilised by the addition of a suitable agent and where the clay content is less than 30% cement would be satisfactory, for higher clay contents stabilisation with hydrated lime would be more appropriate. The addition of the stabilising agent will aid the compressive strength of the block and improve durability under weathering actions.

Compaction of a stabilised material in the BrePak with a pressure approaching 10 MN/m^2 allows the full advantage of the stabilising agent to be realised.

Mixing

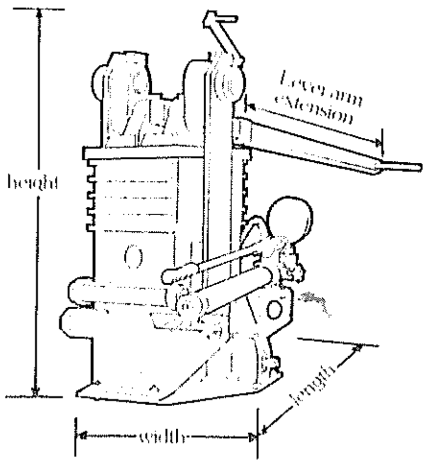
Mixing of the soil should be carried out after the excavated soil has been dried (under the sun), crushed and sieved (5mm) at which time the lime or cement may be added (approx. 6%–10%). The necessary water is required to 'bind' the mix and aid production and also to work with the stabilising agent, the amount of water is approximately 12% by weight.

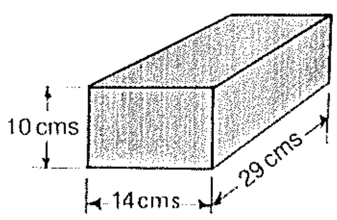
In general 0.3 cu.m. of mixed material will be required per hour to keep the press working equivalent to approximately 8/10 Kgs per block.

Final mix proportions and amount required per block is ultimately found by on-site trials in actual working conditions.

Technical Statistics

1.	Overall length (excluding lever arm)	790 mm
2.	Overall width (excluding ejector ram lever)	510 mm
3.	Overall height	760 mm
4.	Lever arm extension	1500 mm
5.	Press weight	159 Kgs
6.	Lever arm weight	11 Kgs
7.	Ejector ram lever weight	2 Kgs
8.	Effective thrust on mould base plate	44 Tonnes
9.	Effective thrust from ejector ram	6.5 Tonnes
10.	Effective compaction pressure	10 MN/m^2
11.	Average production rate	35/40 blocks/hour
12.	Labour force required	5/6 men
13.	Standard block size	29 × 14 × 10 cms





SHIPPING SPECIFICATIONS

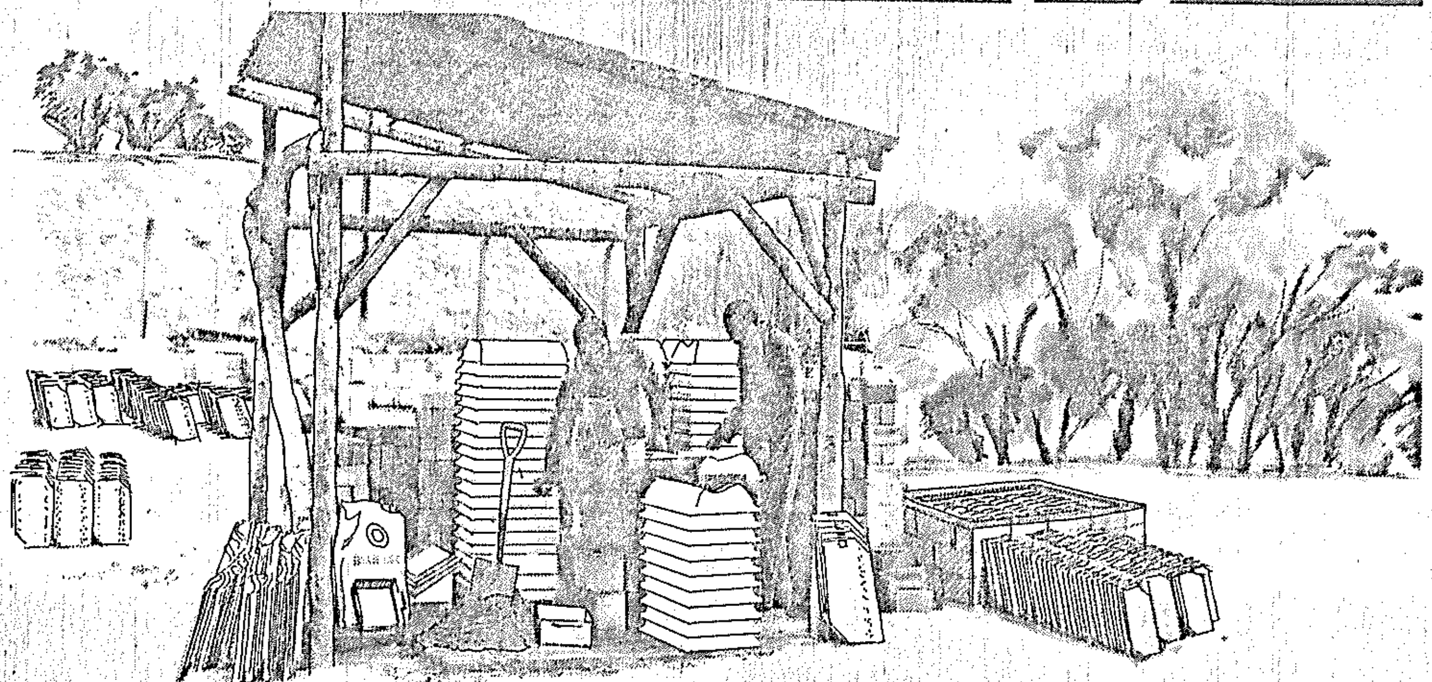
Length	840 mm
Width	620 mm
Height	920 mm
Approx weight	180 Kgs

MULTI BLOC
Crews Hole Road, off Blacksworth Road, Bristol BS5 8AX.
Tel: Bristol (0272) 551951 Telegrams: Weldwell, Bristol. Telex: 44716.

Now Introducing

The HP '500'

only £1720 F.O.B.



500 high quality roof tiles a week from a completely hand powered production plant

Operates anywhere with 50 square metres of work space

- Makes 100 tiles in 4 hours consuming only 1 bag of cement, 150 kilos of sand, and up to 2 kilos of chopped fibre.
- Robust and well-engineered for rapid, reliable production with two operators.
- Spare parts supplied, easily fitted, rarely needed.
- Comprehensive users' manual provided with every plant incorporates 10 years' experience.
- Training, if required, can be provided at our U.K. workshop and at certain overseas locations.
- Full technical back-up services to customers.

THE HAND POWERED VIBRATION SCREEDING MACHINE

- ★ Heavy duty construction
- ★ Well proven vibration mechanism (incorporating the key components of our electrically-powered machines)
- ★ Independent of all power sources but completely replicates the functions of the electric vibrating machine

3 ALTERNATIVE PRICES AND SCALES OF OPERATION

1. HP 250 hand powered machine 50 moulds Ancillary pack	£990 FOB Pack weight 124 kgs Box dimensions 66 x 84 x 90cms
2. HP 500 1 machine 100 moulds Ancillary pack	£1720 FOB Pack weight 155 kgs Box dimensions 66 x 73 x 112cms
3. HP 1000 1 machine in full size work station 200 moulds Ancillary pack	£2540 FOB Pack weight 291 kgs Box dimensions 121 x 66 x 108cms

Optional extra:
Conversion kit to alter plant to operate on 12 volt D.C. electric power £60

PARRY ASSOCIATES

INTERMEDIATE TECHNOLOGY WORKSHOPS

J.P.M. Parry & Associates Ltd.,
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West Midlands B64 7DD. U.K.
Telephone: (0384) 69171 (3 lines)
Telex: 334132 IT PARR-G

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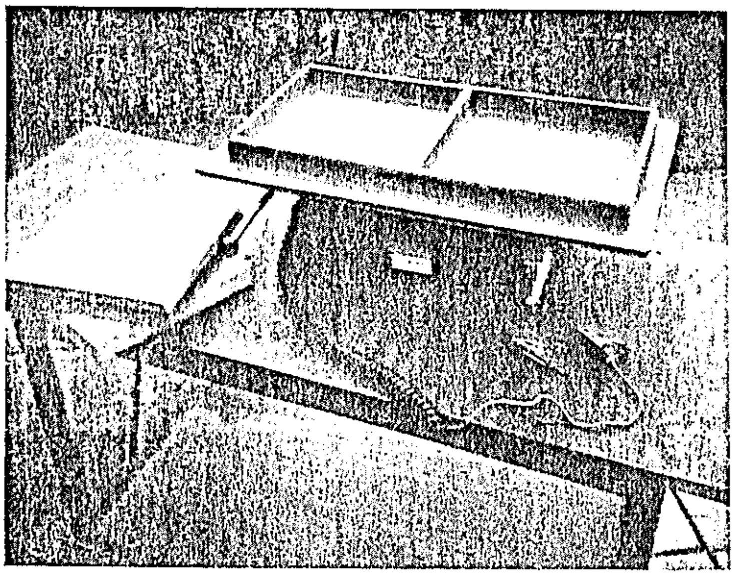
PRODUCT & PROCESS INFORMATION

TECHNICAL DATA SHEET 801

MOULDS TO PRODUCE FLOOR QUARRIES FOR HEAVY DUTY, HIGH QUALITY FLOOR FINISHES

The new moulds are made from a carefully-selected rubber compound combining the properties of good flexibility enabling instant release of the product, with sufficient firmness to retain an accurate shape while setting. An investment of £250 will secure sufficient moulds to produce 100 tiles a week.



The good quality of finished product is achieved by vibration compaction of the mould during filling. It is designed to fit on the table top of all JPA and ITW roof tile vibration screeding machines incorporated in ITW 500 and 1000, HP 500 and 1000, and JPA 1000 and 2000 units

ANNEXE 3

SCHOOL BUILDINGS -MATERIAL REQUIREMENTS

Description	Unit	Quantity	
		Type 1	Type 2
Sand	Cu.ft	1000	1500
Stone	Cu.ft	860	1300
Mud	Cu.ft	2000	2300
Timber	Cu.ft	60	70
Bush Poles 4" diameter	No.	120	150
G.I. Sheets	No.	120	160
Cement - 50 Kg. bags	No.	300	400
Nails 4" long Guage 7	No.	570	680
Nails 3" long Guage 9	No.	240	280
Nails 1 " long Guage 13	No.	610	750
Screws 1" long Guage 8	No.	660	810

Screws 3/4" long Guage 4	No.	580	710
T Hinges 14" long	No.	12	15
T Hinges 9" long	No.	72	88
Tower Bolt 4" long	No.	72	88
Hooks and Eyes 5" long	No.	36	44
Rim locks with keys	No.	4	5
Set of 1 Rose, 1 Escutcheon, 1 Spindle and 2 Knobs for above rim lock	No.	4	5
Pin Boards 8' x 4'	No.	5	7
Paint Brush 4"	No.	2	2
Paint Brush 2"	No.	2	2
Sand Paper	No.	20	24
Evo Stick 528	Lit.	5	7
Emulsion Paint	Lit.	63	87
Gloss Paint	Lit.	21	25
Primer (wood)	Lit.	11	13
Blackboard Paint	Lit.	6	8

ANNEXE 4

SCHOOL BUILDINGS - EQUIPMENT AND TOOLS

1. Block Making Machine ....1.No.
2. Mould for concrete blocks ....1.No.
3. Machetes.. ....5.No.
4. Shovel ....10.No.
5. Pickaxe.. ....5.No.
6. Mattocks.. ....2.No.
7. Felling Axe ....2.No.
8. Earth Rammer ....4.No.
9. Crowbars... ....2.No.
10. Headpans....................................... ....20.No.
11. Wheelbarrow ....4.No.
12. Buckets ....10.No.
13. Hammer 4lbs ....2.No.
14. Hammer 8lbs ....2.No.
15. Mason Set ....1.No.
16. Carpenter Set ....1.No.