CHAPTER 8

Rural Housing

Introduction

Housing scenario in the rural India is more appalling than the urban agglomerations. As per NBO estimates, there was a shortage of 20.4 million dwelling units in 1991 in the country. The quality of housing observed in the rural areas is an indicator of the abject poverty, tremendous socio-economic disparity and extreme backwardness prevalent in the countryside. Inadequacy of infrastructure facilities in villages is very obvious from the fact that protected drinking water supply through tap was available only to 15% of the households in villages, and about 89% households in rural areas did not have sanitary latrines in 1988. Slush, dirt and unhygienic environment are generally synonymous with the human settlements in rural areas.

Traditional Practice of Rural House Construction

A majority of rural houses in the country are constructed with mud wall and thatch roof (Fig. 8.1). In places where stone is locally available, as in Rajasthan, Gujarat and hilly areas like Himachal Pradesh, houses are constructed with stone wall and roof comprising of stone slab and slate etc. Timber and bamboo are used in north-eastern States of Assam, Meghalaya, Tripura, Nagaland, Mizoram, Arunachal Pradesh and Manipur. Bricks and tiles are used as building materials in the rural areas of Uttar Pradesh.

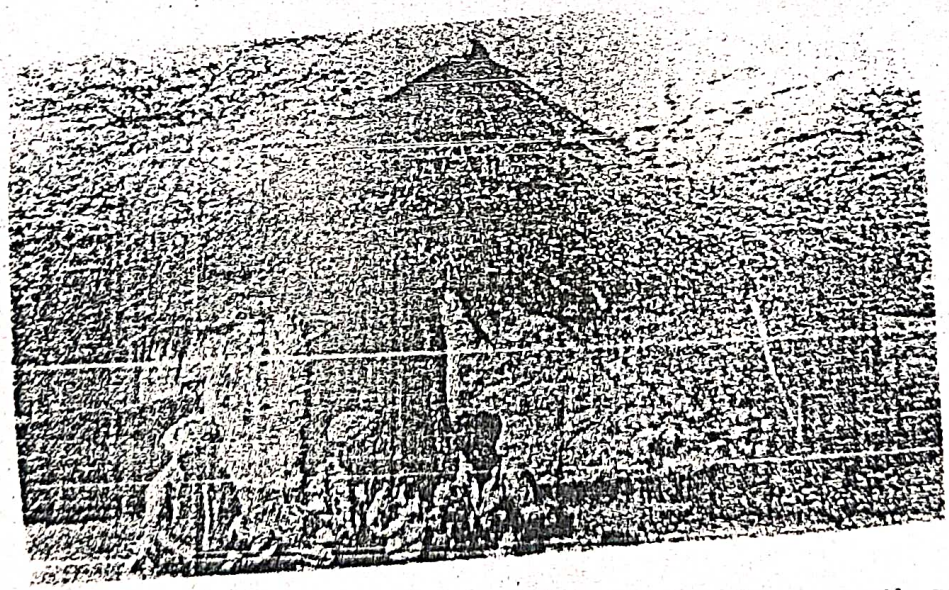

Fig. 8.1 Traditional rural housing in a Rajasthan village

Madhya Pradesh, West Bengal, Bihar, Punjab, Karnataka, Kerala, and Tamil Nadu, etc. In construction of traditional rural houses age-old conventional methods are normally employed.

Appropriate Rural Housing Technology

In the present context, the appropriate technology for meeting the requirements of rural housing in the country will be the one which emphasises on judicious blending of the technological advancements in the field of building technology, living habits and financial capabilities of the rural people with due importance being accorded to optimisation of the locally available building materials.

The NBO Regional Housing Development Centres (RHDCs), the Central Ministry of Rural Areas and Employment, HUDCO, various state Rural Housing Co-operatives, and Government of Kerala etc. have been instrumental in promotion of cost-effective and appropriate rural housing technology in the country. Improved designs of village houses were evolved by the RHDCs to make them more hygienic and liveable. The centres have put up clusters of demonstration low-cost rural houses in selected villages across the country. Over 81 such clusters (Fig. 8.2 and 8.3) comprising of 10-20 houses along with measures for environmental improvement have been put up in different geo-climate regions of the country with the objective of educating the rural people about the innovations in low-cost housing technology. This has been done with emphasis on optimisation of locally available building materials, which could help bring down the cost of construction as well as make rural houses more durable and liveable. The list of the cost-effective construction techniques and indigenous materials, which have been extensively tried out under the cluster demonstration rural housing projects, is provided at Annexure I. Items of environmental improvement provided in the aforesaid projects included sanitary latrines,

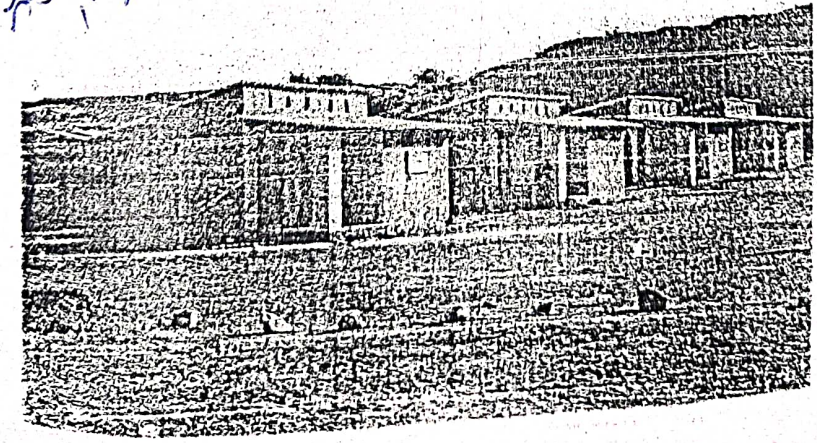

Fig. 8.2 NBO cluster demonstration rural houses in a Gujarat village constructed in stone masonry

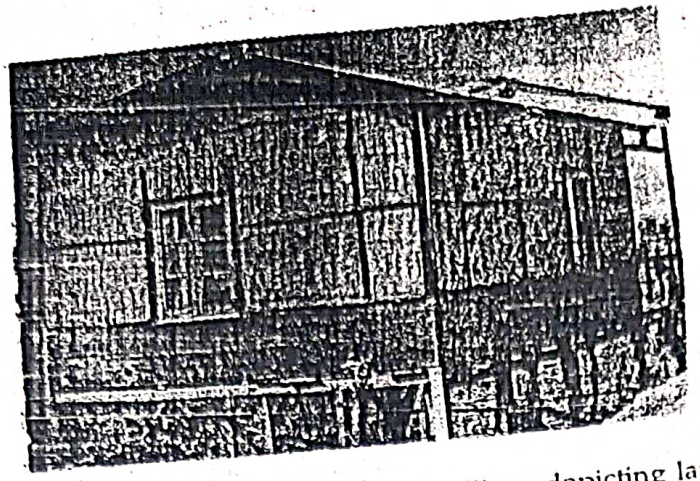

Fig. 8.3 NBO demonstration house in a Mizoram village depicting larger use of timber

paved streets, smokeless chulhas, bathing platforms, supply of potable water and provision of streets and open space etc.

Mud Housing Technology

Mud is a principal building material in many developing countries. The local soils have been used for the construction of such houses. As per an estimate, 8 out of 10 rural houses in the country are either kutcha or semi-pucca and are built with mud walls and thatch roof employing self-help. Virtually, in every continent of the world-from the dry deserts of the Middle East to the rain forests of South America, from impoverished Asia to the affluent Europe, examples of mud buildings are abound, and apart from their regional variations, mud is the predominant building material all over the world, especially in the countryside. Versatility of earth as a building material is illustrated Fig. 8.4.

In Asia and Africa, as well as in parts of Europe and Latin America, where most people still live in villages, there is an age-old relationship with the earth. In Nigeria's hot and humid climate, the mud-bamboo and mat house is the only viable choice, its latticed walls open to the breeze and deep overhangs keep the interior cool and dry. Similarly, in the hot arid Dra Valley in Morocco, where earth is the only material available, mud-house huddle closely together to keep out the desert dust and heat. The arch and dome, which have now become established symbols of Islamic architecture, have their origin in the mud brick structures of the Middle East.

There are at least 20 different techniques in use the worldever. Though they vary enormously, six of them are commonly used.

a) Mud Lump (Cobwall)

This is the simplest method of construction of mud walls. In this technique, local soil which is neither too clayey nor too sandy is mixed with requisite

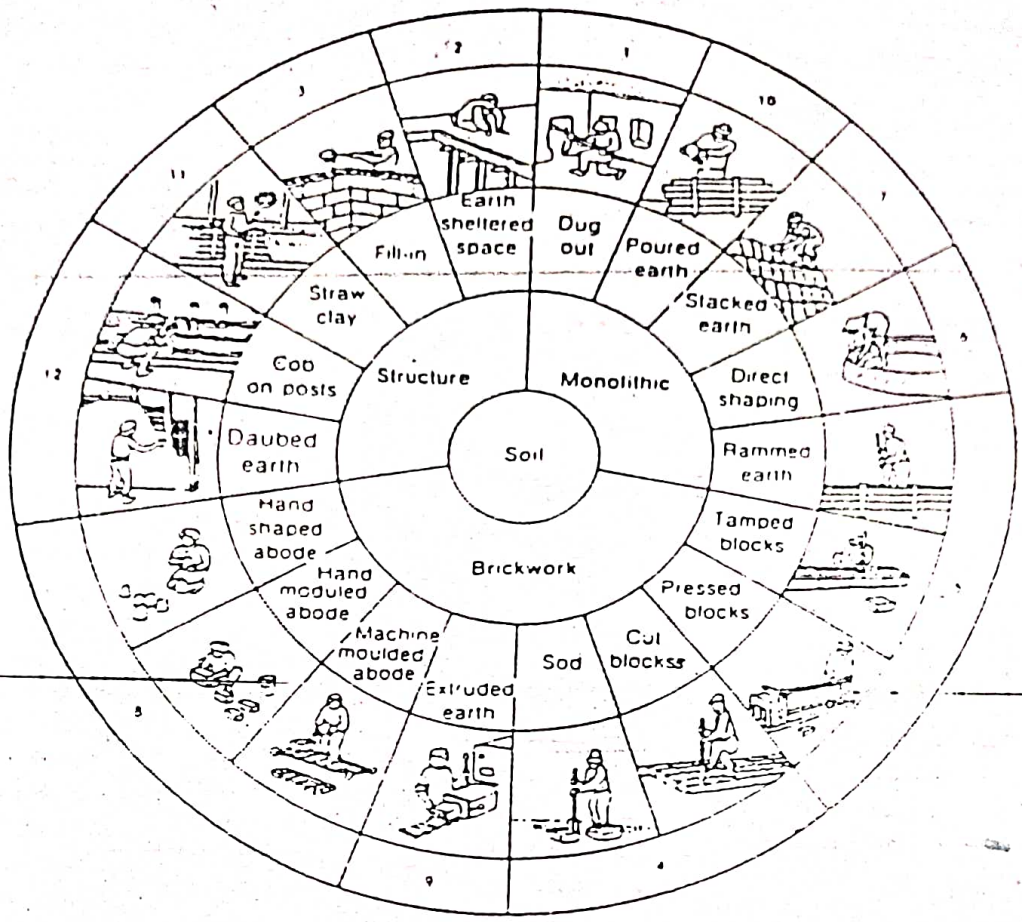

Fig. 8.4 Use of earth as building material (after Bibl. 141—reproduced with permission from SKAT, Switzerland)

amount of water to form lumps of good consistency. Lumps are placed one over another manually. Each layer is placed on alternate days to make allowance for sufficient time for drying. Wall so constructed is then plastered with a coat of mud-mixed with some organic material such as cowdung. Generally, height of such wall is low, not exceeding 2.4 m and thickness about 30 cm.

The roof for such construction normally comprises of bamboo or wooden trusses placed at regular intervals on the mud wall which support the wooden purlins and rafters. Thatch or country tiles is used for covering the roof. The roof overhang of such houses is generally kept between 30 to 45 cm. Such houses are built at very low cost through self-help, though they are not very durable and strong.

b) Wattle and Daub

This is one of the simplest and cheapest forms of wall construction. For many people in Africa (e.g., Swaziland) and Asia it is the only way they can afford to build their houses. Wattle and daub basically refers to a

framework of vertical poles, tied together with horizontal branches and plastered inside and outside with mud.

c) Sun Dried Mud Brick (Adobe)

Under this method, walls are prepared from sun dried bricks. For preparation of sun dried bricks, any soil which is found to contain 80% clay and 20% sand, or 40% clay and 60% sand may be used. Water is added to the soil in the requisite quantity and then the prepared mud is moulded into the shape of bricks/blocks of suitable size with the help of wooden mould. The green dried mud bricks are used for construction of walls. The bricks are laid in courses in mud mortar. The wall is raised in stages, about 1 metre high every day. The mud wall so prepared is well formed and strong.

Sun dried much bricks are known as 'adobe' in Mexico and the USA. Such bricks are very popular in south India, Egypt, Peru, New Mexico, Southern Africa and West Tunisia. The State of New Mexico in South Western USA has developed a regulatory code for mud buildings which covers mainly adobe (sun dried mud bricks).

Manually prepared sun-dried mud bricks are now becoming common in rural India. Though they are normally larger than kiln-fired bricks, they do not conform to any standard size. Such bricks usually make stronger walls than mud.

d) Rammed Earth (Pise de terre)

Rammed earth (pise-de-terre) (Fig. 8.5) is a technique where mud is

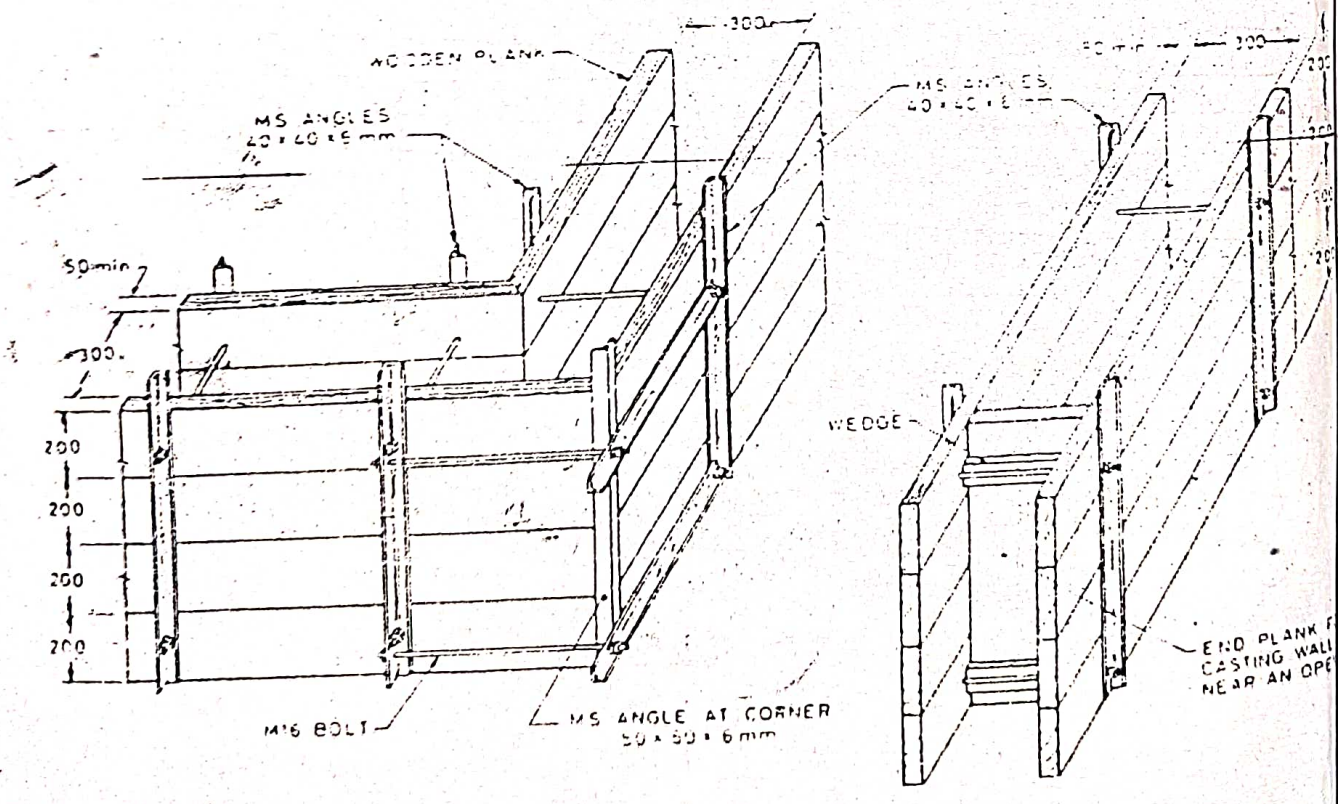

Fig. 8.5 Formwork for rammed earth construction

rammed manually between two moveable timber shutterings (vertical frames) which are erected where the finished wall will be. The preferred type of soil for such construction is 'sandy loam.' The soil prepared for ramming is just moist enough to form a compact ball when it is pressed between cupped hands.

The walls are built in courses. The height of the course is determined by the size of form work, which is generally not more than 80 cm. for 30 cm. thick wall. After one layer has been rammed, the shuttering is raised, a second layer of mud rammed onto a first layer, and so on.

Rammed earth technique of wall construction has been used for centuries in Venezuela and Colombia.

In India, rammed earth was first tried out in 1948 in the construction of 4,000 houses at Karnal (Haryana). These houses have been in use for more than four decades now. The Bureau of Indian standards has also brought out a code of practice (IS: 2110-1980) for the construction of rammed cement soil walls for rural houses.

c) Compacted Soil Block

The technique of production of compacted soil block is relatively young in comparison with others. Compacting the soil in a small form produces a block, which by virtue of the increased density, is both stronger and more water resistant than an ordinary mud brick. Such blocks can be produced by compressing earth into a solid block in machine called the 'Cinva Ram.

Mud Roofs

Mud roofs are made in several parts of the world by plastering mud over a mat of bamboo sticks supported by wooden beams. Making strong roof an entirely with mud has proved to be an extremely difficult proposition. Flat mud roof involves heavy supporting timber work and is costly.

In India, mud roofs are not as common as mud walls, but they are still widely found in a belt ranging from Jammu and Kashmir in north to the Deccan plateau in south, an area covering Jammu, Punjab, Himachal Pradesh, some parts in Uttar Pradesh, Madhya Pradesh, Rajasthan and central parts of Maharashtra. In south, mud roofs are found only in some parts of Karnataka and Andhra Pradesh. The Indian mud roofs are normally flat, with mud used to cover a supporting platform of wooden planks, reeds, bamboo matting or stone slabs. Mud is beaten down and plastered occasionally with an emulsion of cowdung. Layers of leaves are sometimes added to prevent the mud from dropping through.

Mud Brick Vault and Dome

Making strong roof entirely with mud has proved to be an extremely difficult task. The only technique by which a roof can be made entirely with sun dried mud bricks was invented over 6,000 years ago in the Middle East: the vault. Some ancient vaulted roofs in the arid Middle East are now over

The mud brick vault-and dome building system was evolved centuries ago in West Asia. It was a response to necessity, for roof-spanning materials such as timber and reed became more and more scarce as populations grew in the hot, semi-arid regions. It is also the unique response of the ancient West Asian architects to the fact that sun-dried mud brick has strength in compression but not in bending or tension.

Domed or vaulted roofs are extremely used in Iran and Turkey. In Europe, vaulting involves laying masonry over a wooden form work, which is later removed when the vault became dry. But in the West Asian construction, no supporting formwork is required for fired or sun-dried brick. If sun-dried bricks are used with mud mortar, the bricks fuse together on drying, since they are of the same material. This gives the vault additional strength.

Characteristics of Mud

Advantages

i) It is a truly natural, cheap and local material—available in most parts of the world.

ii) It provides excellent heat insulation, so the internal part of a mud building is cooler in summer and hotter in winter than a building made with steel and concrete. Due to this property, mud houses are most suited in tropical and sub-tropical climatic conditions.

iii) It is strong in compression and so makes good walls. It can also be made strong in sheer and tension through additives and reinforcement.

Disadvantages

Mud has some serious disadvantages which are as follows:

i) It is eroded easily by water, which makes its use difficult in areas with high rainfall or possibilities of flooding.

ii) It has low strength, which means mud roofs are difficult to make.

iii) It is susceptible to mechanical damage. Rodents can easily make hole in mud walls and under the floor, or thieves can dig their way into the house.

iv) Mud does not grip wood properly, so gaps often develop around wooden doors and windows in mud walls. Consequently, mud houses often have few openings and are badly ventilated.

v) Mud soaks up water and becomes very heavy. As a result, the wooden beams supporting a mud roof begin to sag, the mud cracks and the roof starts leaking.

vi) Mud houses behave very poorly in the event of earthquakes.

Overcoming Disadvantages of Mud

Centuries of trial and error have generally produced designs appropriate for local conditions. There is, however, always scope for improvement. A

Cornish proverb has it that "All a mud house needs is a good head and a good pair of boots," meaning thereby that all a raw-earth building needs to survive is a 'pucca' (stone or concrete) foundation, and overhanging roofs to save walls from water.

Most of the disadvantages associated with mud houses can be overcome by suitable improvements in design and technology, such as soil stabilisation, appropriate architecture, and improved structural techniques. As the majority of the people in the developing countries will, out of necessity, continue to live in mud houses, ways of improving on the traditionally built mud houses have been evolved out of sustained research in the direction.

The Central Building Research Institute (CBRI), Roorkee, has developed non-erodable mud plaster for making mud houses more durable. The water-repellent treatment for mud walls consists of mixing cut-back bitumen with ordinary mud plaster prepared with bhusa (paddy/wheat chipping) and cowdung. The water-repellent mud plaster is prepared by mixing upto 5% (by weight) cut-back with ordinary mud plaster comprising of mud and bhusa (paddy/wheat chipping) in the proportion of 70 Kg bhusa to one cubic metre of soil. The cut-back, an emulsion of bitumen (90/100 grade), is prepared by hot mixing 50 Kg bitumen, 10 litres of kerosene oil and 0.5 Kg of wax. For every cu.m. of soil 70 Kg of cut-back is added. The mix of soil, bhusa and cutback is thoroughly mixed by turning over and kneading to get a homogeneous mix. The mortar so prepared is applied in the usual way. When the plaster has dried, a coat of gobri-leaping (cowdung mixture)-1 part gobri and 1 part soil and cutback in the same proportion as for plaster is applied over the dried surface of plaster. The plaster thus rendered can withstand the rains for 3 to 5 years without major maintenance.

Fire Retardent Treatment for Thatch Roof

Thatch is the most common roof for mud houses. It is, however, vulnerable to fire hazards. In order to make the thatch roof fire retardant, the top and bottom surfaces of the thatch roof are plastered with 20 to 25 mm thick layer and 10 mm thick layer of bitumen stabilised mud plaster, respectively. Over this plaster, two coats of gobri leaping are applied to improve the finish. Furthermore, this is left to dry to receive spray of bitumen solution. Bitumen solution is prepared by mixing hot molten bitumen and kerosene oil in the proportion of 1:2. One coat of this emulsion is either sprayed or applied by brush on the top surface of the plastered thatch. The second coat follows after three to four hours. Two coats of lime are then applied over the bitumen-sprayed surface.

Soil Stabilisation

Researches have identified around 130 different stabilising agents including cement, lime and bitumen. Before deciding the correct type of stabiliser to be added to the soil, thorough testing of the soil is essential.

The best type of soil for stabilisation with cement is one which has a

proper grading of particles of different sizes, from the sand range to fine clay. Very clayey soil, particularly black cotton soil, is best stabilised with lime, and bitumen is suitable for sandy soils. In some cases, a combination of stabilisers should be used. Highly plastic soils, and soils containing organic matter are not suitable for stabilisation.

The following percentages of additives are found most suited to achieve the desired strength to manufacture stabilised bricks/blocks, resistance to weathering and to effect economy. The exact quantity of stabiliser to be added depends on the type of soil. As a rough guide, the following could be adopted under normal situations:

Sandy soils: 5% cement stabilisation

Clayey soils: 5 to 6% hydrated lime and 2% cement

Normal red soils with upto 25% clay: 2 ½ % hydrated lime.

Lime combined with flyash makes a cement almost as good as Portland cement. This is used as a stabiliser for both sandy and clayey soils.

Of all the stabilisers, cement has been the most extensively used. Soils which are treated with lime are not as strong nor as water resistant. Soil stabilised with cement or lime can also be compacted in a Cinva Ram. In India, apart from the Cinva Ram, some of the popular soil-block making machines in vogue are 'Ellson block master,' 'Balram' and 'Astram.' On average, about five hundred 23 × 19 × 8 cm. pressed-soil blocks can be made with the 'Astram' machine per day, and about a thousand 23 × 11 × 7.5 cm. blocks with the 'Balram'.

The Stabilised bricks are usually sun-dried, and laid in ordinary mud mortar, although stabilised mud mortar would be better. They are protected with a covering of non-erodable mud plaster from the outside, and with ordinary mud plaster from the inside.

The stabilisation of soil with the addition of Portland cement, lime, bituminous binder, industrial wastes like flyash and bagasse, etc., can improve the bearing strength of bricks and render it increasingly water and moisture repellent. Of the various additives, cement bricks (with 5% cement) though better in strength (about 4 N/mm²)* are poor in water and moisture resistance, whereas bitumen-stabilised bricks (with 1% bitumen) though poor in strength (about 3 N/mm²), are good in water and moisture resistance. Stabilised bricks can be laid in ordinary mud mortar or stabilised mud mortar; the latter one, of course, is preferred from strength and durability considerations. Experiments have been carried out at the CBRI, Roorkee to reduce the amount of bitumen from 1.0 to 0.5% through the use of industrial wastes like flyash and bagasse as additives. The use of rice husk cement has also been tried for the stabilisation of soil with promising results.

Application of Science and Technology for Rural Areas (ASTRA) at the Indian Institute of Science (IISc), Bangalore, and the NBO RHDC, Bangalore, have played an important role in the promotion of soil cement blocks as useful building component for house construction in Karnataka. As a result of promotional work undertaken by the ASTRA and the NBO RHDC, five stabilised mud housing programmes involving construction of about 7,000 houses have been undertaken in different parts of the State.

* 1 N/mm² ≈ 10 kg/cm²

The major advantage of the stabilised soil block vis-a-vis the burnt brick is the significant saving in energy (about 70%). Such blocks are cheaper by 20 to 40% compared to burnt bricks. A study of the performance of the soil blocks used in the construction of houses undertaken by the Karnataka Housing Board has revealed that the compressive strength obtained from such blocks ranges from 3–7 N/mm². Up to two-storeyed houses, 5% cement or 2 ½ % cement and 2 ½ % hydrated lime stabilised soil blocks possessing a minimum compressive strength of 3.5 N/mm² could be used. Soil stabilised blocks are gradually being accepted as alternative to burnt bricks in Karnataka. Large number of private builders in rural and urban areas in the southern states of the country, especially in Karnataka are using such blocks in house construction.

Soil Stabilisation by Traditional Water Proofers

Various traditional materials ranging from plant juices to cowdung are mixed with mud for rendering mud walls. Such treatment renders mud walls more water repellent.

In northern Ghana, an extract of boiled banana (or plantain) stems is mixed with lateritic soils. In Upper Volta, a plant extract locally known as 'am' is used as varnish. In Northern Nigeria, 'laso; (an extract from the vine 'vitis pallida,' locally known as 'dafara') and 'makuba' (made from fruit pod of the lowest bean tree) are used for waterproofing of mud walls. Cowdung mixed with clay has been widely used in Ghana and India. In Sudan, 'jaloos' (mud) houses are treated with 'Zibla,' a local water proof material made from cow or horse dung. Straw has been mixed with mud since Biblical times, especially in West Asia. In Ethiopia, straw (preferably 'chid' the straw of millet) is used in mixing 'chika' or soil paste.

Rural Housing Programmes

In a country like India where about 75% of the population lives in 5.83 lakh villages, a rural housing programme is necessarily an aided self-help programme. Such aided self-help is the technical systemisation of the well-known traditional principles which have a bearing on co-operative efforts. Over the past two decades, number of rural housing programmes have been undertaken in the Government and co-operative sectors. Some of the prominent rural housing programmes undertaken in the country are described below.

(i) In order to ameliorate the living conditions of the landless rural poor, the Government of India had introduced a scheme envisaging provision of house-sites to the landless agricultural families in rural areas free of cost in 1971 in the Central Sector as a component of the Fourth Five-Year Plan (1969-74). Under the said scheme, the State Governments and the Govt. of Union Territories provided house-sites measuring minimum of 82 sq.m. (100 sq.yds.) free of cost to 14.5 million landless rural families who did not own house sites nor built-up houses. The beneficiaries were expected to build modest houses through self-help. The scheme was transferred to the state sector with effect from April 1, 1974, and was also

included in the Minimum Needs Programme (MNP). The scheme had been continued in the Fifth Five-Year Plan (1974-79) wherein its scope was extended to other landless workers who were bonafide artisans such as potters, carpenters, fishermen, blacksmiths, etc., who had no house-sites of other land of their own. The scheme was accorded high priority through its inclusion in the 20 Point Programme announced by the Prime Minister in July 1975. The scope of the said scheme was further broadened in the revised New 20-Point Programme announced in 1980, according to which construction assistance was to be provided to some 3.6 million households during the Sixth Five-Year Plan (1980-85). So far 194.23 lakh rural landless workers have been provided house-sites, and 60.25 lakh families have been given construction assistance on allotted house-sites.

(ii) Rural Housing Co-operatives can play an important role in the integrated rural development by mobilising saving and channelising community action not only for the construction of houses but also for the management of community facilities. This is being taken advantage of in some developing countries notably India, Pakistan, Malaysia, Thailand and Sri Lanka.

In India, with a view to encourage housing in rural areas, the Maharashtra Co-operative Housing Finance Society provides long-term credit on priority basis. Similarly, in Andhra Pradesh, the Scheduled Castes and Scheduled Tribes Co-operative Housing Federation has provided a large number of houses to the rural poor through utilisation of loans received from the Life Insurance Corporation of India. Besides, the Tamil Nadu Co-operative Housing Society, the Karnataka State Co-operative Housing Federation and the Rajasthan State Co-operative Housing Finance Society have played a significant role in providing affordable houses to the rural people.

(iii) In 1973, the Government of Kerala had launched a scheme popularly known as 'One Lakh Housing Programme.' Under this programme, 100 houses were to be constructed in each of the existing 1,000 Panchayats in the State at that time. The houses were to be provided to one lakh landless poor families whose poor affordability prevented them from having their own houses. The construction of houses under the scheme was undertaken by the Panchayats. The State Government mobilised funds for undertaking such a massive programme for rural having through collections, donations and grants. The final figure in respect of houses constructed was, however, 60,000 which was still a creditable achievement by any standard. The major lacuna in this scheme was non-particiation of beneficiaries in construction of the houses and they kept complaining about the quality of construction of the houses and they pressurised the Government for grants to repair the houses year after year.

In 1982, the Government of Kerala introduced a new scheme called the Subsidised Aided Self-Help Housing Scheme for the Economically Weaker Sections known as 'SASH' with the involvement of voluntary organisations. The main thrust in 'SASH' was to involve beneficiaries fully in construction of houses to overcome the lacunae experienced under the One lakh Housing Schemes. The programme, though conceived in 1982, was implemented in full swing during 1984-85. The entire loan assistance for this programme was provided by HUDCO. Over 800 voluntary organisations have since

participated in the implementation of the aforesaid housing scheme in Kerala.

iv) Over the past one decade, the Ministry of Rural Areas and Employment (MRAE) under the Government of India, has undertaken number of schemes catering to the housing needs of the rural poor. The Indira Awas Yojana (IAY), launched during 1985-86 is fully subsidised by the Central Government. This is a scheme of the construction of low cost houses for the poorest of the poor belonging to the SCs/STs and freed bonded labour in the rural areas. The overall target during the Seventh plan (1985-90) was for construction of one million houses. The scheme is now also extended to non-SC/ST families, with ceiling of expenditure on such families being 4% of the total allocation. The IAY has since became part of the Jawahar Rozgar Yojana (JRY). The latter was initiated in 1989 by merging the National Rural-Employment Programme (NREP) and the Rural Landless Employment Guarantee Programme (RLEGP). Over 18.43 lakh houses have been constructed with a financial involvement of Rs. 2,197.49 crore since its inception till November, 1994.

(v) The HUDCO is actively engaged in evolving designs and financing of low-cost rural housing programmes in the country. It started financing of rural housing schemes in 1977. It has since financed 1,496 projects envisaging construction of more than 27.3 lakh housing with a loan commitment of Rs. 1043.32 crore.

(vi) The Government of India has recently approved a scheme to supplement the efforts of the States and Union Territories to give an impetus to housing for the weaker sections and people in the rural areas during the Eighth plan-period (1992-97). This is to involve allocation for capital subsidies for rural housing as well as allocation of resources for internal subsidy and setting-up 300 rural centres to popularise low cost building materials.

Under the new scheme, the States and Union Territories will receive matching allocation for rural housing schemes meant for the weaker sections. It covers sites and services; shelter upgradation and construction of new houses. Funds are to be provided to States on equal proportion to the expenditure incurred by them on housing programmes for the poor under the MNP. This support will be available to the States in a flexible manner to help them continue with their existing programmes which are suffering for want of adequate resources.

The allocation for rural housing during the Eighth plan is Rs 350 crores. A sum of Rs 12,000 is to be given to those below the poverty line for this purpose. The subsidy will be shared equally by the Centre and the States. For borrowers, who have to pay loans over a period of 15 years, there will be an interest subsidy upto 4.5 per cent. Housing subsidies are presently provided through the Indira Awas Yojana for Scheduled Castes and Scheduled Tribes, allotment of house sites-cum-construction assistance under the MNP. The HUDCO supported loan schemes for economically weaker sections, whereas the LIC/GIC funded loan schemes for the State Governments.

Typical Specifications for Low Cost Rural Housing

For the guidance of prospective builders and construction agencies