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Selection of Materials

2.1 Soils and their Characteristics

Soil is a generic term for the end product of the weathering process of rocks. Soil characteristics can vary widely depending on the nature of the parent rock and the type of climatic influences at a particular site. Soils, further, consist mainly of three types of particles.

a) Sand

Sand is nothing but grains of quartz varying in size from 0.075 mm to 2.0 mm. It is hard and chemically inert.

b) Silt

Silt particles are also grains of quartz but are much finer than sand. They range in size from 0.002 mm to 0.075 mm.

c) Clay

Clay particles are finer than 0.002 mm. Chemically, they are products of weathering of felspar and can vary in chemical

searching for a material which is relatively more durable than mud when exposed to rain impact. Whenever stone is easily available it has been used for construction. In other locations, burnt brick has evolved as a durable building material. Burnt brick, on the other hand, needs thermal energy for its production. This thermal energy has to come either from coal or from firewood or other biomass. Use of coal or firewood has an environmental implication and there is a need to reduce the energy requirement in the production of a stable building material.

2.2 The Stabilized Mud Block

Since, mud (soil) is the most widely distributed resource for building construction it is useful to explore ways of 'stabilizing mud' without employing an energy intensive technique like brick burning. 'Stabilized mud' may now be defined as, mud which does not soften due to the action of water, by the use of a small quantity of a binding agent. Cement, lime, cement and lime, lime and pozzolana, bitumen and organic binders are some of the typical 'stabilizers' which can be used to produce a 'stabilized mud block'. The performance of a soil based building block depends to a considerable extent on its density. Low density blocks are rather porous and will not have good strength. It is hence necessary to densify a soil while making a stabilized block, besides adding the stabilizer. For this purpose, the soil has to be subjected to adequate pressure at suitable moisture content. This process is known as 'compaction'. The compaction can be done inside a machine mould to produce a standard sized 'mud block'. Alternatively, the soil can be directly compacted in a wall using a movable mould in what is known as 'rammed earth' construction. As a rule, it is desirable to produce a 'stabilized mud' with a dry density of 1.80 to 1.85 gm/cc.

Thus, the process of stabilized mud block (SMB) making has two steps: firstly, the right type of soil has to be mixed with a

specified amount of a stabilizer and secondly, it has to be 'compacted' into a high density block at suitable moisture.

2.3 Selection of Soils for SMB Manufacture

At the outset, it must be pointed out that it is relatively easy to stabilize soils which are non-expansive in nature. While it is possible to develop techniques for stabilizing expansive soils like black cotton soils, it is desirable to avoid such soils in view of the complexity in handling them.

For soils containing non-expansive clays, a clay percentage of about 15.0% could be considered as the upper bound for satisfactory SMB production. At the lower end, soils can have a low clay content of about 5% with no harm to the SMB making. If a soil has more than 15% clay, it may need more than 10.0% cement to stabilize it and the process of SMB making can become expensive. If the soil is sandy, a sand content in the range of 65.0% to 75.0% leads to a satisfactory SMB. With the clay limitation of 15% and a sand requirement of 65%, soil can have about 20% silt. In case, the soil is too silty, the sand requirement can be reduced suitably, keeping the clay content still at 15.0%. For such soils, a silt + sand content may be specified as 85%. If the soil contains excessive amounts of fine silt with low clay and sand contents, block making can be problematic due to lack of green strength. Addition of clay like fines (like fly ash) and coarse sand can correct the situation.

Detailed information on the influence of soil types on the SMB characteristics can be obtained from the work of Venkatarama Reddy (1991) and Reddy and Jagadish (1995).

Soils with significant amounts of organic matter (more than 0.5%) are generally not suitable for stabilization by cement. However, the traditional building soils of North Karnataka and Maharashtra, known as 'Haalu Mannu' in Kannada and 'Pandri Mathi' in Marathi are an exception to this. These are organic soils

of 10.0% lime and 2% cement can be utilized to stabilize the soil. It must, however, be noted that mixing black cotton soil and lime and cement is not easy. Pan mills are usually employed to carry out satisfactory mixing of such soils and lime. The influence of different stabilizers on the characteristics of stabilized blocks is discussed by Venkatarama Reddy (1983, 1991).

2.5 Waste Materials for Building Blocks

A variety of inorganic wastes are produced by the industries in India. Quarry dust from granite crushers, fine particles from stone polishing industry (granites, marble, slate polishing), red mud from aluminum factories, mosaic floor polishing waste and fly ash are some of the typical industrial wastes which can be added to soils while making stabilized mud blocks. Waste from gold mines can also be used. The use of rock dust from Kolar goldfields for stabilized blocks has been studied by Yogananda and Jagadish (1992) and Sudhakar Rao et al. (2002). In general, such wastes may be used in small proportion (say 20% of the sandy soil). Sometimes, it is possible to make stabilized blocks using a combination of fine material and sand or quarry dust. Such blocks may be referred to as 'fine concrete' blocks. Since such blocks do not contain clay, they usually give relatively higher strengths. Achieving strengths of the order of 5.0 to 8.0 Mpa is not difficult while adopting 'fine concrete' blocks.

Building debris from demolished buildings often contain significant amount of sandy material, lime, etc. The sandy material can be sieved out and used in SMB manufacture in place of sand or quarry dust.

It is also possible, sometimes, to use larger quantities of 'fine wastes' provided the efficacy of such proportions is verified through experiments. It is especially important to check against long-term strength reduction by testing blocks after 1 year and after 2 years.