ABSTRACT

I. General

Lime and surkhi were important building materials in India till some 70 years ago. These materials were used in all the ancient historical structures which stood for centuries. Although early strength of lime or lime-surkhi mortars are not high, in view of the massiveness of the structures in those days built on dead weight principles, these mortars served their purpose adequately and satisfactorily. It is only after the First world war that the use of cement as a major construction material became popular particularly due to its availability as a standardised material and its high early strength characteristics enabling use of slender structures. After independence during the successive Five Year Plans, the construction activities in the country increased many fold as a result of rapid industrial and socio-economic growth and the cement industry is not able to cope up with the enhanced demand. The gap between the requirement and the production of cement has increased over the last several years. At the onset of the Sixth Plan, the estimated requirement was 30 million tonnes of cement, as against the available 27 million tonnes per year. Also there is an annual consumption growth of 8-10 per cent on account of the implementation of irrigation projects, hydel schemes, new industrial projects and
building construction. More than Rs.100 crores is being spent on importing of cement. Besides large initial outlay with sizeable component of foreign exchange involved in the establishment of cement factories, increase in cement production cannot be stretched indefinitely because of limitations in the availability of special grade limestone required for the purpose. Keeping this in view, the urgent need for scientific development of alternate cementing materials is realised. Towards this end, studies are undertaken here on composite lime mortars using cement as an admixture in low percentages upto a maximum of 25 per cent with a view to develop the same for use in low-cost housing. Also studies are conducted using certain organic admixtures like Vitis Quadrangularis (Nalleru), Aloe Vera (Kalabanda) and jaggery for the same purpose.

The shortages of houses in the urban areas was 2.5 million units in 1951 which increased to 5.3 million 124.9 million housing units exist as enumerated in 1985; by 1961/2 95.2 million in rural areas and 29.7 million in urban areas. The latest estimate of housing shortage in the country at the beginning of the 7th plan is 24.2 million units consisting of 15 millions in rural areas and the rest in urban areas. Between 1985 and 2000 A.D., an additional of 90.8 million housing units are required to be built. The Sixth Plan budgeted for
an investment of Rs.12,900 crores for housing during the plan period. The distribution of this amount being Rs.3,500 crores in rural areas and Rs.9,400 crores in urban areas. This will provide 13 million rural housing units and 6 million urban units.

II. Objectives

The investigations have been carried out with the following objectives.

1. To conduct systematic studies on lime, lime with low percentage of cement as admixture and lime concrete with a view to develop these materials as alternative construction materials to cement mortar and cement concrete, particularly for use in low-cost houses, both in urban and rural areas.

2. To develop composite lime mortar mixes which have equivalent strength to the commonly used cement mortar mixes,

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4. To study the effects of admixtures from naturally available plants and other organic sources.
5. To study the economic aspects of the above with reference to low-cost housing.

III. Materials and Methods

1. Studies have been made on the workability of lime from three different sources in Rayalaseema districts of A.P., using the same principles as in cement, with emphasis on unslaked lime.

2. Experiments have been conducted on the workability of composite lime mortars (unslaked) on one source of lime, with different percentages of cement as admixtures.

3. Studies have been conducted on strength characteristics of lime mortar mixes from three different sources in Rayalaseema districts of A.P. Strengths in modulus of rupture, compression and direct tension (briquettes) are studied for both slaked and unslaked lime.

4. Strength and workability studies on lime concrete have been carried out for both slaked and unslaked limes from three different sources. Slump and compaction factor tests are conducted for workability. Compression and indirect tension by split tests have been conducted for determining strength.
5. Studies have been conducted on strength characteristics of lime mortars with cement as admixture in percentages smaller than recommended by ISI, for three sources of lime of slaked and unslaked varieties.

6. Chemical analysis as per I.S. Standards have been done on both slaked and unslaked varieties from three different sources of lime.

7. Strength studies have been done on lime mortars with admixtures of Aloe Vera (Kalabenda), and Vitis Quadrangularis (Nalleru) and jaggery.

8. Tests are conducted on brick pillars of one brick square with height of 300 mm and 600 mm. Different composite lime mortars and cement mortars are studied for comparison.

9. Studies are conducted on hollow building blocks with composite lime mortars.

10. Cost comparison is done for composite lime mortars of equivalent strengths with the usual mixes of cement mortars and lime mortars in use.

IV. Conclusions

The composite lime mortars give as much strength as the usual mixes of cement mortar 1:6, 1:7 and 1:8
and hence can replace these cement mortar mixes in brick
colornstruction. Also equivalent mixes in composite mortars
to the usual lime mortar mixes can be used in low-cost
housing.

Lime concrete can be used in place of cement concrete
in foundations of load bearing walls and as a base course
under flooring. Hollow blocks of composite lime concrete
have sufficient strength and hence can be used in low-
cost housing. The other conclusions are presented at
the end of each chapter.

V. The following papers are published based on the work
as reported in the thesis.

1. "Some studies on the workability of lime mortars",
The Indian Engineer, May 1979, pp. 1-5.

2. "Some studies on strength characteristics of lime
mortar mixes of Rayalaseema, Andhra Pradesh, Journal
of the National Buildings Organisations, Vol. XXV,
No. 2, October 1980, pp. 29-35.

3. "Strength and workability studies of lime concrete
from lime samples of Rayalaseema Districts of Andhra
Pradesh, Proc. of the 43rd Annual General Meeting
of the Institution of Engineers (India), A.P.
Centre, April 1981, pp. 1.2.1-1.2.8.

4. "Strength characteristics of Composite lime mortar
mixes of Rayalaseema, A.P.", Journal of the National
Buildings Organisation, Vol. XXIX, No. 1, April 1984,
pp. 1-10.