CHAPTER 1
INTRODUCTION

1.1 GENERAL

The common burnt brick is one of man's great inventions and it is essentially a local building material. There exist considerable variations in the quality of raw material, the process of manufacture and the quality of finished product. Earlier the term brick was used for building units made of clay. Now a days brick can be considered as a regular prism of suitable size that can be handled conveniently. Hence the terms such as kuchcha brick, burnt brick, stabilised soil brick, concrete brick, silica brick, flyash bricks are also in vogue. Brick and brick masonry have been extensively used in construction for last many centuries and it continues to dominate among the commonly used construction material.

Brick possess inherent structural efficiency and aesthetic value and hence it is widely used as a structural as well as a filler material. Easy availability of raw material and relatively less technical manufacturing process has made brick an economically acceptable building material to a large section of the society. This common burnt brick is usually pleasing in appearance with colour ranging from cream, through orange sandy colours to brown and even blue brown. When built into a wall, pleasing and interesting simple patterns appear. Bricks uniform in shape, size and colour can also be manufactured by wire cut machine.

Archeological study shows that, the inhabitants of Indus civilisation were using sun dried clay bricks in their cities. During the era of Indus civilisation and the fourth century B.C. brick has been replaced by stone for monumental and religious structure. This has happened due to permanence of stone. During period of Moghal rulers, brick was given a secondary status. However a renaissance of the use of brick and brick masonry occurred
with the arrival of British in India. As far as Marathwada is concerned Nizams have ruled over this region and hence most of the important constructions have been carried out in stone masonry. However, in some areas important works have been carried out in brick work.

Now a days, in India, well known planners have also developed very good forms of building with brick masonry. The era of low cost housing emphasises on low cost technology, labour intensive use and environmental friendly architecture that seeks the use of brick for different components of a building. Now the use of stabilised soil brick and silica brick have started in India. There is more scope for research and development of manufacture of stabilised soil bricks by using locally available soil and modifying agents.

1.2 BRICK INDUSTRY IN INDIA

Manufacture of clay bricks is perhaps the oldest industry in the history of mankind. It is reported that hand shaped, sun dried mud bricks were made and used during the pre-pottery Neolithic period as back as 10,000 B.C.[30]. In India, use of brick in construction sector is an age old process. Today total production of bricks is found to be of the order of 1,00,000 million. [31] Traditionally adobe, sun dried kuchcha and burnt bricks are produced in India. At present, burnt clay bricks, clay flyash bricks, flyash bricks, lime silica bricks, stabilised soil bricks are produced in the country. The use of silica bricks and stabilised soil bricks are likely to become popular construction material in near future. Application of Science and Technology for Rural Areas (ASTRA) at the Indian Institute of Science, Bangalore and NBO, RHDC, Bangalore, have played an important role in the production of soil-cement blocks as useful building component for house construction in Karnataka.

Burnt clay brick is defined as a locally available building material, rectangular in shape with a frog as an indentation on the top face, which acts as a key for the mortar to
hold the upper brick firm in position. The usual procedure of manufacturing clay bricks consist of weathering of raw materials, mixing, moulding, drying and then burning in clamp or kiln. The quality of bricks produced depends on the raw materials, suitable modification by admixtures if necessary, workmanship and method of firing bricks. Bricks manufactured from alluvial soils and burnt in kiln are found to be of very good quality. Burning of bricks in kiln is very popular in North India, whereas majority of brick manufacturer in other part of India adopt process of burning bricks in a clamp.

Exploration of bricks from various parts of India, their size, and period in which these had been used are given in chronological order of their use in Chapter 2.[68,70] History reveals that bricks of various shapes and sizes were manufactured by our forefathers for specific use only. Trapezoidal, triangular, pentagonal and various special shaped bricks were used for the construction of arches, domes, decorative works, wells, etc. Plates 1.1 and 1.2 show two different views of one of the fifty two gates of the Aurangabad city constructed in brick masonry. Plate 1.3 shows a typical brick masonry tower and plate 1.4 shows a photograph of a house constructed in brick masonry. Plates 1.5 and 1.6 show old brick masonry constructed by using bricks of different sizes than practised at the present time. All these plates reveal that, good quality bricks were manufactured even in the past in the Marathwada region.

1.3 PROBLEM FACED BY BRICK INDUSTRY

Bricks play a very important role in the construction industry of the country. The availability of good quality bricks in adequate quantities is important for the construction programme to be undertaken. Brick industry and related construction activity sector is the biggest employer of seasonal, migrant and casual rural labour. Nonavailability of good quality bricks in adequate quantities is one of the biggest problems before the country.
Plate 1.1: Photograph of one of the ancient gates of Aurangabad city.

Plate 1.2: Close up of the gate in plate 1.1
Plate 1.3: Photograph of one of the brick tower in Aurangabad city.

Plate 1.4: Photograph of a typical village house showing brick work in Marathwada region.
Plate 1.5: Photograph of the brick masonry-walling element of a house at Aurangabad.

Plate 1.6: Photograph of the brick masonry compound wall of a house at Aurangabad.
Hence, it is necessary that the government gives top priority to promote growth and development of brick industry. There has not been much change in the last 100 years or so in the methodology of brick production. Because of steep rise in prices of land, coal, wages and other material, the entire industry is in crisis.

Coal is the basic raw material used in burning of bricks and accounts for 60 to 70% of the cost of bricks. The coal at present being supplied by Coal India Limited (CIL) to brick industry is of the inferior quality. As far as Maharashtra is concerned, B or C grade steam coal from coal mines in Chandrapur/Yavatmal district is primarily used as fuel in firing open clamps.

Brick industry is labour intensive. At present industry is facing the main problem of nonavailability of skilled labourers. The availability of skilled labour is scarce, hence employers are at the mercy of labourers. Employers have to pay hugh advances to labours without any security. Every year many kilns of the country are closed for nonavailability of skilled or semiskilled labours. Thus in the existing circumstances it is difficult to maintain the quality control.

As far as financial assistance is concerned brick industry is the most neglected one. Though Government of India, had already recognised brick industry as a small scale industry, state governments are not extending all benefits and financial assistance to the industry.

1.4 NEED OF THE MODIFICATION OF SOIL FOR MANUFACTURE OF GOOD QUALITY BRICKS

Soil for brick making is available virtually almost every where. Obviously, some soils may be ideal and some unsuitable. Misunderstanding in this regard is that alluvial soil is the only suitable soil for brick making, but most of the soils can be made satisfactory for brick making with little modification. Suitability of soil and other additives is solely decided by trial and error method and no laboratory testing is ever employed by manufacturer of
bricks. Black cotton and similar plastic soils are not considered suitable for brick making. Due to their stickiness, release of wet bricks from mould becomes very difficult and during drying shrinkage results into cracking and breakage. Soil maps, as generally presented, have limited value in the selection of a soil source for soil base components in construction. Standard soil maps classify the soils geologically in several broad categories and further identify them, some what as to mineral make up, age and geologic source. Soils can be considered as "young" or "old" also.

To manufacture good quality bricks, brick manufacturer faces two important difficulties. Firstly the variability of local soils makes it difficult to frame the rules for the manufacture of good bricks consistently. Secondly the untreated soils lack strength and dimensional stability. Hence soils should be modified for manufacture of good quality bricks.

Brick being principal building material the quality of brick must be improved. Normally there being no control over the quality of this product, the designers assume very low strengths in their designs. As there is no demand for quality bricks, which will cost little extra to the consumer, the manufacturers on their part do not try for the quality bricks. Similarly, consumers of brick industry are not quality conscious, rather they give more weightage to cost per thousand number. This is a vicious circle, it can be broken by the design engineer, who should specify standards for the bricks to be used in their constructions. The sub-standard bricks should be rejected without any hesitation. This will compel the manufacturers to have strict quality control and good quality bricks will fetch some more value in the market. It is, therefore, absolutely essential to impose restrictions on the quality of bricks to be used in constructions. This can be checked by testing the bricks, from every lot and rejecting substandard ones. Such restrictions should be imposed on bricks to be used in constructions belonging to private parties also.
Testing of bricks is compulsory for government agencies. This, however, is not being followed properly. Bricks being selected at random for testing purposes by the engineer in charge of the works and not by the supplier or the contractor who are the interested parties. As per IS 3495-1992 [142] number of bricks to be tested should not be less than five per lot. Bricks being not a standard product and also quality being dependent on so many factors, the testing of bricks in all the cases will definitely improve the quality. Engineers alone will make the people test-minded by insisting on quality bricks. This will be the only way of getting improved quality bricks.

1.5 OBJECTIVE AND SCOPE OF THE PRESENT WORK

The bricks available in the Marathwada region are not consistent in dimensions, compressive strength, water absorption the basic important properties of bricks. Hence statistical analysis of properties of bricks of Marathwada region is carried out. The main objective of this work is to give practicable solution for the manufacture of consistent, good quality bricks from the locally available soils and resources. This study is important as the physical properties of soils of Marathwada, a backward region of Maharashtra, are studied and remedies have been proposed. The experimental work has proved the utility of soil either parent or modified for manufacture of cost effective, and better quality bricks. Present day manufacturer of bricks in this region is not based on systematic research and hence the bricks are not uniform in quality or at times lack in mechanical properties. As such, this research work, will add to the general know how of the manufacture of good quality bricks, with special reference to Marathwada.

With all these factors and parameters in considerations, this research work leading to experimental studies is undertaken and an experimental investigation programme is carried out. The work consists of studying properties of bricks of Marathwada by statistical
analysis, modification of soils of Marathwada for manufacture of good quality burnt and stabilised soil bricks, finding optimum mixes to produce bricks of good properties. The work is also carried out to study the effect of size on properties of bricks. The strength of brick masonry depends on strength of brick and mortar used for masonry work. The other important factors are curing period, workmanship. Thus the strength of masonry may change for bricks manufactured in the region. Hence, the behaviour of brick masonry prisms in compression, by using local bricks and cement mortar of different proportion is studied. All these studies carried out are discussed in detail in the subsequent chapters.

1.6 EMPHASIS GIVEN IN THE PRESENT WORK

Brick manufacturers do not carry out the testing of soil for deciding the suitability of soils for brick making. For this purpose, manufacturers generally rely on their judgment. This, however, sometimes fails and the final products get fused, cracked and warped. The facility of testing of physical properties of soils is available in all engineering colleges and polytechnics of the region. If desired some of the brick manufacturers can owe the laboratory set up for finding the physical properties of importance. With these considerations, significance is given to the determination of physical properties of soils and for giving practicable solution based on the experimentation carried out, for manufacture of burnt bricks and stabilised soil blocks. The theoretical background related to manufacture of brick is discussed in detail.