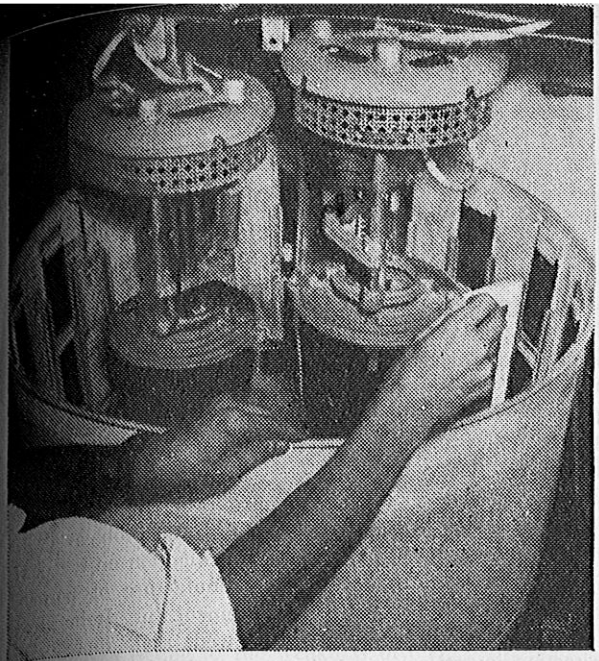
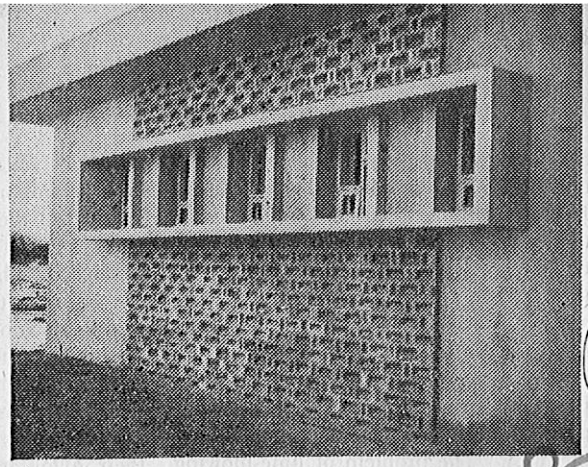


Weatherometer for Testing Paints



Deep Frog Brick Walling

RESEARCH ON MATERIALS AT THE C. B. R. I.

Organised building research is of recent origin. Its main objective is to help the building industry towards a better understanding of materials and processes, to assist in the development of new materials and techniques and to provide scientific information. As a branch of applied research it is concerned with such widely varying subjects that it is best organised in a number of divisions in which detailed attention can be given to different aspects within the framework of an unified approach to problems of building 'as a whole'. These problems range from the settlement of foundations to the correct use of new materials, from construction techniques to subjective reaction of the user to lighting systems.

Research on materials is the concern of the Building Materials Division which aims to help the building industry and profession by developing new materials, utilizing waste products and by providing testing facilities which normally do not exist elsewhere. Research, both fundamental and applied, is directed towards the assessment of materials, to their standardisation and specification and towards the solution of problems arising out of the failure of materials in structures. In such researches the heterogeneous nature of the materials, their varied origins, their limitations and the different types of problems they raise preclude anything but a systematic approach along many different lines involving the specialised knowledge of the physicist, the chemist, the geologist, the engineer and others. It has been found convenient to group the work of the division in various sections for the purpose of detailed study, though each section freely draws on the knowledge and experience of the others from time to time. At present these sections cover Heavy Clay Products, Cementitious Materials, Building Stones and Aggregates, Organic Building Materials and Paints and Varnishes. In addition, there are specialised workers dealing with X-ray, Differential Thermal Analysis, and the petrographic and analytical studies of materials.

The Problems

Problems connected with research on materials may be divided into three classes. First, problems dealing with the testing of materials, the determination of their physical and chemical properties and the development of special procedures for evaluating their durability and compatibility with other materials. The data accumulated from such studies help in the selection of materials for specific purposes. Secondly, problems arising out of the failure of materials in structures, such as, efflorescence, chalking and cracking of paints, corrosion and general deterioration. A lasting solution to problems of this type generally requires a systematic approach which is often basic in nature. And lastly, in dealing with new materials or the new use of existing materials, problems arise in connection with manufacturing processes, economics or adjustments in construction practices.

The Heavy Clay Products Section is largely concerned with problems affecting the brick industry. Some of these problems arise out of the nature of the materials used, others with the operations of manufacture.

Solutions to some of these problems are facilitated by the knowledge gained in the recent years by the application of X-ray and D.T.A. techniques to the study of clay mineralogy. However, solutions arrived at under laboratory conditions need very cautious interpretation and pilot scale studies or even trial runs under actual manufacturing conditions are necessary. The work covered in recent years includes studies on raw materials, kiln performance, partial mechanisation, perforated bricks, colour in bricks and similar studies.

Brick Earths

A series of studies was carried out on the properties of brick earths from different parts of the country, including the effect of the mechanical composition of soils on the properties of the fired bricks (1). While soils from the Ganges Valley are eminently suited for brick manufacture, the same is not true of soils from other areas. Bricks manufactured from black cotton soil are usually irregular in shape, highly porous and are weak in strength. Their poor quality is attributable to the expansive nature of the clay and the presence of lime nodules.

Investigations have led to the development of an improved process which obviates the use of coal ash as an opening material and replaces it by calcined

clay (2). The clay is calcined at low temperature and rendered non-plastic. It is then pulverised and mixed with the black soil. The addition of calcined clay improves the workability of the raw mix and reduces the drying and firing shrinkage of the bricks. The new process results in bricks which are denser in texture, have a higher compressive strength and lower water absorption than those normally manufactured. The problem of lime-blowing is solved by immersing the bricks drawn from the kiln in cold water, a process commonly known as "docking".

Even when the soil is suitable, the quality of the fired brick depends appreciably on the temperature of firing, the rate of heating and cooling and the composition of the kiln atmosphere during firing or, in short, on the design and operation of the kiln. The Bull's Trench Kiln, used extensively in India for brick burning, has several drawbacks, namely, the low output of well-burnt bricks, its high fuel consumption, the absence of any control over firing and the operational difficulties involved in the use of the movable chimney.

In order to remedy these defects, several improvements have been incorporated in an experimental kiln designed by the section. This kiln is provided with a flue system which controls the draught and the chimney is fixed outside the kiln. These modifications give a higher output of well-burnt bricks and allow more rigid control over the firing process. The economic effect of these improvements is now being examined.

Decorative Bricks

Little attention has been paid in India to the production of facing, decorative, perforated, lightweight and engineering bricks. Research on the possibility of providing such bricks at economic prices in India has been undertaken. For example, deep frog bricks are easy to manufacture manually, require less clay and fuel and cost less to transport. Their use effects an economy in mortar consumption and tends to increase the mason's output.

Many factors have to be considered in fixing the optimum size of the 'frog', but the major consideration must be the ease with which the bricks can be moulded manually. The frog tentatively suggested is 'U' shaped with top dimensions as 7"x2.5", tapering to 6"x1.5" at bottom and having a depth of 2"

Another example, coloured bricks besides imparting a pleasing appearance to the building, obviate the need of external rendering on the masonry. Their development involves the identification of factors responsible for colouration in bricks, the development of suitable pigments and their compatibility with brick earths under the conditions of firing, their strength characteristics and the economics of their manufacture. The process developed in the section would appear to fulfil the needs of the industry.

Apart from these researches, a considerable part of the work in the section is concerned with the manufacture of bricks in different parts of the country. To cite an example, the section investigated the suitability of soil found at Kandla and recommended a process for making good bricks out of the local soil.

Building Stones

Building stones constitute an important class of materials used for the purpose of walling, flooring and roofing. A knowledge of their durability and strength is of prime importance since they have a direct bearing on the design, construction and maintenance of the buildings in which they are used. Whereas, strength tests are fairly well standardised, methods of assessing durability have yet to be rationalised. The study in the Division involved the identification and evaluation by analytical and petrographic studies of the factors responsible for weathering and decay. It was observed (3) that the decay of sand stones was mainly due to the crystallisation of soluble salts, derived either from soil, water or background material, which exert initial pressure on crystallisation and thus cause disintegration of the stone structure. A test method involving the immersion of specimens in a solution of sodium sulphate has given reliable data on the durability of sand stones.

In the cementitious section attention has been paid to the utilisation of waste products, natural or industrial. Thus the low-grade gypsum of Rajasthan has been studied with a view to making suitable plaster and boards for building purposes. It was found (4) that building plaster and boards conforming to the standard specification could be manufactured economically from such low-grade deposits. A suitable retarder which is indigenous was also developed. Similarly, it was observed that Sindri ash after necessary processing can replace about 10 to 20 per cent of portland cement in the manufacture of puzzolanic cements. It was also observed that the ash was a suitable source for lightweight aggregate in concrete used for non-load bearing members (5).

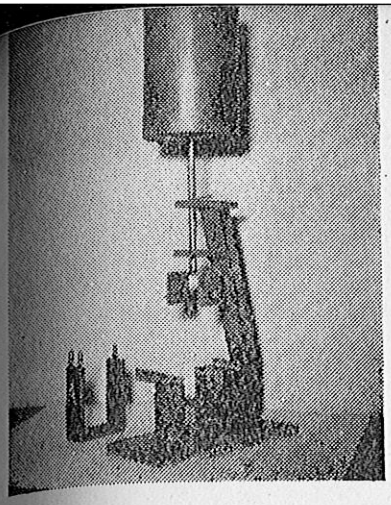
Cements

Blast-furnaces yield large quantities of slag as a waste product and confront the industry with the problem of its disposal. An investigation on the possibility of the manufacture of portland blast-furnace cement in India from such slags showed that these, after granulation, were suitable for the manufacture of cementitious materials of the portland blast-furnace cement class (6). These investigations were extended to explore the possibility of making supersulphated cement which are more resistant to sulphate action than ordinary portland cement.

Research on cements, such as, hydrophobic cement, non-shrinking and expanding cement, are in hand to obtain the technical know-how of their production and to observe the performance of these cements under Indian conditions. A large number of exploratory trials showed that neat expanding cements (composed of three parts of portland cement and one part of expanding component) on 7 to 10 days' curing under water resulted in an expansion of 0.5 per cent for the mix using Kaolin, 0.75 per cent for the mix using slag, 2.0 per cent for the mix using bauxite and 2 to 3 per cent for the mix using high alumina cement. Subsequent dry curing at room temperature resulted in about 0.15 per cent shrinkage corresponding to the portland cement component in the mix.

Asbestos

Besides the researches described so far, the Building Materials Division has interested itself, at one time or the other, in the study of a number of other items including asbestos vermiculite, bloated clay aggregate, etc. It is known that the strength of the sheets using Indian tremolites fall far below accepted specification. The too tensile strength and short length of tremolite fibres are usually considered to be the main causes for the low transverse strength in these sheets. Research in



Assembly for Preparing Bond Strength Test Specimens

progress indicates that the low-strength of the sheets is due to the weakness of the continuum (glassy phase or gel structure) formed during the setting of cement

Detailed investigations on the characteristics of Bageshpure (Mysore) vermiculite indicated that although these exfoliated to about 9 to 10 times the original volume, the density (7 lb. per cu. ft.) of the exfoliated product was not as low as that of the South African sample (Palabora: 4.2 lb. per cu. ft.). Subsequently, vermiculite samples from Chatia, Ulatotoli and Dutkigora were also included in the study. These studies (7) have established the suitability of indigenous sources for the manufacture of low-density vermiculite products and the optimum conditions of their exfoliation.

Paints

Present-day research in India on paints and painting is to a large extent confined to the field of the individual organisation interest. Industry at certain places carries out developmental investigations with a view to maintaining market lead or capturing new markets. The problems that are encountered in the use of paints in building construction arise out of the materials used and their application. A wide range of problems, such as, paint specifications for different uses, the development of test procedures, particularly for predicting durability, the formulation of new paints to prevent or retard corrosion, for fire protection or antibacterial growth and for other uses, all need investigation.

The Division's efforts have been confined, so far, to tests on paints with a view to collecting data for use in specifications and accelerated weathering tests on paints and their correlation with natural exposure tests. In the absence of data on the flow properties of Indian paints, systematic investigations were carried out to determine the flow and other related properties of the paints available in the market. The plastic viscosity data were obtained by a rotational type of viscosimeter while the efflux type of viscosimeter was used to measure the consistency in arbitrary units (8). Investigations such as these, when corroborated by other research workers, serve as a basis for future specifications, and also help to make the consumer conscious of the quality he should expect from a particular paint.

In India, the failure of paints is mostly due to chalking, fading and loss of gloss. With a view to correlating these effects with the results of accelerated tests on paint films, a systematic study on the natural and accelerated weathering of paints was initiated. The work carried out so far indicates that a general correlation is possible.

Organic Materials

The organic building materials comprise timber, bituminous felts, silicones, resinous adhesives, flooring compositions, etc. The Division has conducted a series of experiments on the use of silicones as water repellent coatings on masonry and mud walls. Though silicones are popular in the west, their large-scale use in this country as a water-repellent coating on masonry should be preceded by research with a view to finding the efficacy and limitations of the process under the tropical conditions. Some of the items of research on organic building materials with which the Division is concerned at the moment is development of non-skid flooring, polish, asphaltic roofing felts, etc.

Collaboration

While these are some of the main lines along which the work of the Building Materials Division is being developed, a few types of *ad hoc* research problems which the Division carries out for statutory bodies is mentioned. Recently, the Division has collaborated with the Structures Division in a series of tests on 'The Strength of Brick Masonry with Different Mortars'. These studies, carried out for the National Buildings Organisation, are helpful in the writing of a Code of Practice on Brick Masonry. Often, such studies have led to side investigations with interesting results. For example, in the programme cited above, a side investigation was conducted on the standardisation of testing of tensile bond-strength in brick-couplets. Another example, 'Renderings for Foamed Concrete Panels', was the subject of a test programme for the Hindustan Housing Factory, which the Division has concluded successfully.

The Division organised recently a Research Workers' Conference on Building Materials which was attended by delegates from Research Institutes and industry. These conferences afford an opportunity for workers all over India to establish contacts.

It may be said that the work of the Building Materials Division, over the years, has resulted in the accumulation of experience, so essential for any research organisation and on which the Division will certainly have to fall back, in the years to come, as the complexity of the problems increase.

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