The composition and properties of cob: a traditional West Country building material

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ABSTRACT

Earth has been and remains a popular worldwide building material. However, there is the need to better understand the performance of this material at a regional level in the United Kingdom. This will ensure existing buildings are better conserved and the role of the material established for the future. The School of Architecture at Plymouth University has embarked upon a research programme to understand cob, the local earth building material in the South West region of the United Kingdom. The initial project identifies the constituents of cob and investigates their effects on its' mechanical performance.

INTRODUCTION

The Context of Cob as a Building Material

The West Country enjoys a rich variety of traditional building materials from the granite of Dartmoor and the slate of North Cornwall to the mud stone of the South Hams. Numerous half timbered structures also survive throughout the region together with the frequent occurrence of buildings made from earth, or cob as it is known locally. Building with cob, or mass mud as it may be described is the process by which a sticky mixture of subsoil, straw and water is built up in horizontal lifts and allowed to harden in to thick solid mass walling (Harrison[1]). Unlike common bricks, cob is allowed to dry out naturally and is generally finished with lime render and limewash.

It has been estimated that between thirty and forty thousand cob buildings survive in Devon alone, (Keefe[2]) with many more in Cornwall. However, the use of earth as a building material is not confined to the South West. It can be found throughout the British Isles including the English Counties of Norfolk, Suffolk, Dorset, Hampshire, Lincolnshire and Cumbria, and in Wales, Scotland and Ireland. Each location has its own name for the material, with variations of ingredients and construction techniques. Although, no national inventory has been undertaken to understand fully the frequency and nature of earth building in the British Isles.

Interest in earth as a building material is developing at a regional level throughout the country, for instance in the DEBA (Devon Earth Building Association), and nationally a network is beginning to form to exchange in formation and experiences.

What is becoming very apparent is that in this current age of conservation,, little is known in this country as to how to care for earth building. In fact it is a material which has of late been given the reputation of being an inferior building material, but has this conclusion been arrived at through ignorance, through inappropriate maintenance for instance ? Does the quantity of building which have survived in this country, some several hundred years old, suggest we can dismiss this material ? What we must do is to endeavour to understand scientifically and technically the characteristics of this material to fairly assess its credibility and ensure its conservation.

Whilst the conservation of earth building is in its infancy in this country, internationally considerable activity has been undertaken in the understanding and promotion of earth as a contemporary building material. (Keefe[2]) Up to half the world's population occupy earth buildings, testimony to the popularity of this material.

"ICCROM (The International Centre for the study of the Preservation and the Restoration of Cultural Property) and CRATERRE - EAG (The International Centre for Earth Construction - Ecole d'Architecture de Grenoble) initiated a collaborative five-year phased project, called the Gaia Project, in response to the need for organised activity in the conservation and preservation of earthen architecture. Established to integrate activities in training, information transfer and documentation, research relating specifically to the conservation of earthen architecture, and technical co-operation with ICCROM'S Member Countries, Associate Members and Professionals active in the field, the Gais Project seeks to address current demands and anticipate future needs. (Gaia Project Research[3]) However, to fully utilise the ever increasing wealth of information available at an international scale, it is important that the earth buildings of the British Isles, including the cob of the West Country are better understood.

DEBA (Devon Earth Building Association)
DEBA exist to provide a forum for the discussion of issues relating to earth building in Devon and the south-west of England. Their aims are:

to provide advice on the repair and maintenance of earth buildings through an information service, the publication of technical guidance and the organisation of practical demonstrations, exhibitions/displays and seminars.

to prepare and publish an earth building manual covering all aspects of the construction, repair and maintenance of earth buildings, including composite structures, daubs, renders and plasters.

to encourage and support training in the field of earth building and associated skills.

to establish mutually beneficial links with groups and individuals working with earth buildings in other parts of Britain and abroad.

to encourage the revival of earth building techniques for new building construction and to investigate the potential of material for low-energy 'appropriate technology' building. (Keefe[4])

THE ROLE OF THE UNIVERSITY OF PLYMOUTH

The University are collaborating with DEBA in order that they may fulfil their aims. The University interests are:

1. Research into earth as a building material.

2. Development and delivery of courses related to earth building, particularly as a consequence of the research, at all levels from general awareness through to the operatives and professionals in the building industry.

3. Consultancy, again as a consequence of our developing knowledge and experience of the material.

An interdepartmental group has already formed within the institution with representatives from the School of Architecture, Department of Structural and Civil Engineering and the School of Manufacturing, Materials and Mechanical Engineering. Research is underway and the development of the earth building courses has begun.

The University of Plymouth are funding a full-time research assistant to investigate the mechanical behaviour of cob in the West Country. We hope to attract further funding in the near future to extend this research as there is much to be done to fully understand the performance of cob and how that knowledge may better determine the material's conservation.

THE INITIAL RESEARCH PROJECT

The Properties and Composition of Cob in the South West
The aims of the project are to:

investigate the effect of the constituents of cob (soil, straw, and moisture content) on its mechanical performance;

develop models to describe its behaviour;

enable the coherent classification of cob.

This research project may be divided into four sections.

1. A pilot programme to establish the validity of the tests used to define the cob and to establish a rudimentary data base.

2. The investigation of the effect of different soils used in the manufacture of cob upon its compressive strength.

3. The study of the load bearing behaviour of a cob wall.

4. The analysis of the desiccation of a cob wall.

Pilot Programme
This involves the study of a limited number of cob blocks manufactured at Bow Hill, an English Heritage site in Exeter, and of a similar number cut from a wall at one other site in Devon.

These blocks are tested to establish their;

moisture content
void content
particle size distribution
straw content
compressive strength
Youngs modulus
strain to failure

During this programme the effect of the volume of the sample occupied by cobbles and the sample size, on the results of the compressive tests will be investigated.

Investigation of the Effect of Different Soils Upon Compressive Strength
Samples of cob will be analysed using the tests verified in the pilot programme. The sample sites will be selected so as to maximise differences in their soil type whilst representing areas in which earth building is reasonably common.

These tests will clarify the role that the various constituents play in the compressive strength of cob.

Study of the Load Bearing Behaviour and the Desiccation of a Cob Wall
To understand how the data accumulated by testing cob blocks may be used to describe the behaviour of a cob structure, 'monolithic' cob walls will be mechanically tested. One such test wall has been found near Silverton, Exeter, another will be built at the University of Plymouth. This purpose built wall will have instrumentation laid in it during construction to enable the desiccation process of the wall to be monitored.

It is hoped that this fundamental investigation into cob that will provide a sound basis for objective judgement on the integrity of the material of particular cob buildings.

EDUCATIONAL COURSES

"There is an almost universal view within the building trades of the South West, and also, it should be said, throughout Britain, that cob is difficult to repair, let alone build with". (Harrison[5]) However, are current interest in conservation demands we do repair these buildings to ensure their survival. We are fortunate that a few craftsmen continue to practice the skill of mending and building with cob, including Alfred Howard. Together with the scientific and technical knowledge accumulating here and abroad, it is possible to create courses to educate at all levels. The University of Plymouth intend to launch a programme of courses by the end of this year.

EARTH AS A BUILDING MATERIAL OF THE FUTURE

Enthusiasm is developing for earth as a contemporary building material. It has many positive attributes in that it can be erected and replaced cheaply using local labour, it is recyclable and appears to cause no adverse environmental effect. Whether earth is a material of the future is yet to be seen, but it is important that science and technology supports the possible promotion of it as a plausible alternative building material.

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