DE DEVON EARTH
BA BUILDING
ASSOCIATION

COB DWELLINGS

Compliance with The Building Regulations 2000 (as amended)

The 2008 Devon Model

INTRODUCTION

There are a number of excellent publications currently available on cob and associated earth building techniques which refer in part to compliance with The Building Regulations.

The specific purpose of this document is to give practical guidance on how traditional cob can satisfy current Building Regulation requirements with respect to low-rise residential properties.

It is intended that this guidance will form the basis of a submission to the Department of Communities and Local Government, the Government department responsible for Building Regulations, to provide a framework for the acceptability of this form of construction by Building Control Bodies throughout England and Wales.

Additionally, LABC (Local Authority Building Control) will be approached to assess the suitability of cob as a method of procurement for LABC System Approval.

System Approval is a certification scheme for building systems where standard components and construction details are used in a variety of different buildings..

The scheme can also help clients who use non-traditional building systems, such as unbaked earth, enabling a simplified route through building regulation approval.

Practitioners may well employ other earth building techniques in the repair of existing cob buildings, including earth blocks, shuttered cob and rammed earth. The materials used in these repair techniques possess similar properties to those of cob as described in this document.

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HISTORICAL APPRAISAL

Cob: The raw material

The basic constituents of cob are straw, water, and sub-soil; it is the choice of the sub-soil, which determines the durability and acceptability of the cob as a building material. It has been suggested that the performance of cob soils was improved by the addition of cow dung which acted initially as a plasticizer and subsequently as a binder inhibiting the dispersion of the clay in winter.

The Devon Historic Buildings Trust reported in January 1992, that Devon contains more earth buildings than any other county in Britain, conservatively estimated at 20,000 houses, and an equal number of barns and other out-buildings.

One reason for this is the composition of Devon soils, which often have ideal proportions of clay, silt, sand and gravel for use in cob construction. These properties enable the clay to provide adequate cohesion to the cob, and afford a well-distributed range of aggregates of coarse gravel through to fine sands and silt.

The addition of straw to the mix performs several key functions; initially it binds the mix together to enable it to be placed on the wall and after placement, the straw distributes shrinkage cracks throughout the wall, acting as reinforcement, preventing the formation of large fissures which are often the cause of premature structural shear failure.

Construction methods

Cob walls are traditionally built off a stone plinth or ‘pinning’, normally 300mm to 450mm above ground level, *(see plate ii)*, although it is not unusual to find buildings with stonework up to first floor level. The Devon saying, ‘all cob needs is a hat and a good pair of boots’, confirms the essential requirement of avoiding moisture saturation of the wall; (‘Water is the principal enemy of all earth walling’), achieved at ground level by the stone plinth and traditionally at roof level by the generous eaves overhang of a thatched roof.

Mixing of the cob material is a critical element of the construction process, which traditionally was undertaken manually with the possible assistance of animals for ‘treading’ of the mix. The sub-soil is broken down, with aggregate greater than 50mm being removed, and laid out on a hard pre-wetted surface to a depth of 100mm on a thick layer of straw. Water is then added, and a second layer of straw is spread evenly on top, before thorough treading or mechanical mixing of the material is undertaken to ensure even distribution of the moisture and straw throughout the mix until it is at the correct consistency for building purposes.

Placing of the mix

A three pronged pitching fork with a wooden handle about 1.2m in length, was commonly used in Devon to place the mix onto the wall in lifts from 300mm to 900mm, which was then beaten and trimmed to the required form.

The mix overlapped the stone plinth to enable it to be pared back with a paring iron after a few days, prior to the next lift, each lift being well trodden in by the workmen. The extent of the projection can vary, although the Devon Historic Buildings Trust (1992) suggests at least a 75 to 100mm overlap.

Renders

Earth buildings need to breath, and are sensitive to dampness and temperature change. It is essential therefore that the correct specification of surface treatment is made to allow for this requirement.

Lime-based materials are suitable, and can be used externally in either repeated lime-wash applications or as a render of lime, river sand and an animal hair binder, [cow hair is preferred, but imported goat hair is more readily available].

Where new finishes are applied that do not allow natural moisture migration of the cob to occur, the structure will become progressively weaker and may eventually collapse. Such finishes include strong cement/sand renders, plasters, and even some modern vapour permeable paints are unacceptable; ‘renders should be weaker than the walling material’.
Further advice on renders can be found in the DEBA leaflet that can be down-loaded from our website http://www.devonearthbuilding.com. The use of water based breathable paints such as ‘contract’ or ‘trade emulsion’ are acceptable.

DEVELOPMENT OF NATIONAL BUILDING REGULATIONS

The Great Fire of London in 1666 did much to introduce and shape the regulation of building in England and Wales.

The London Building Act of 1667 had a prime purpose of restricting the use of combustible materials in buildings. The construction of certain external walls and party walls were to be of non-combustible material. As cob was not a material used in London because of the unsuitability of the clay, no reference was made to this material as having suitable fire resistance.

When other towns experienced the ravages of fire the Councils sought to control rebuilding by the use of Improvement Acts that not only referred to walls but also thatched roofs. The first city outside London to structure a Building Act was Bristol in 1788.

That Act, which was based on the London Building Act, banned over-sailing storeys and set out the thickness required for brick and stonewalls, chimneys and party walls, restricting the use of timber in such walls and appointing Surveyors to enforce the Act. Again cob is not common in Bristol and consequently the Improvement Acts that numerous Town Councils introduced based on these Acts, made no reference to cob.

In 1842, when the first National Building Actwas proposed, Regulation 31 stated that external walls to be built of stone or brick should be properly bonded with good mortar of one to three cement sand mix. These proposals formed the basis of the first Building Byelaws introduced under the provisions of the Local Government Act of 1858.

The Byelaw relating to walls stated that they should be constructed to the thickness specified in the attached schedule that did not refer to cob. When the Borough of Barnstaple adopted the Byelaws in 1875 cob was not permitted despite the fact that many buildings in Barnstaple at that time, of which a few remain today, were built of cob.

Building Byelaws of 1902 referred to walls of brick or stone or other non-combustible material properly bonded and solidly put together. Note the requirement for bonding again, something that mass cob, as a form of monolithic construction, cannot attain. Even the use of small amounts of straw as a binding agent would have resulted in a cob wall being classified as not being constructed of non-combustible material.

Changes in 1912 required only brick and stonewalls to be bonded with cement mortar joints and other non-combustible material being solidly and properly put together. Whilst this appears to provide an opportunity for the reintroduction of cob it was prevented by its omission from schedules of suitable material, such as brick, stone, clunches of brick, flints, cement, concrete or half-timber.

A report published in 1922 by the newly founded Building Research Station entitled “Building in Cob and Pise” whilst expressing a Governmental interest in the use of earth as a walling material did not address the issue of conformity with local Building Byelaws.

There were no changes in the 1939 model Byelaws but the 1953 model introduced "deemed to satisfy" clauses which referred to steelwork reinforced concrete, timber, aluminium, brick, stone and un-reinforced concrete. Again there was no reference to cob.

The first national Building Regulations introduced in 1965, referred to "fitness of materials" when compliance with a British Standard of Code of Practice was the acceptable standard and this applied equally to standards of structural stability. Cob did not have a British Standard.

The Building Regulations 1985 saw a change whereby the specific nature of previous Byelaws and Regulations were replaced by functional and/or performance standards. This approach is a more flexible way of meeting requirements and whilst the Approved Documents do not refer specifically to cob, the Guidance Notes to Regulation 7 (Materials) states that "any material which can be shown by experience such as a building in use, to be capable of performing the function of which it is intended" is satisfactory. **After 150 years of Building Control, cob can once again be considered suitable.**

Nevertheless, lacking definitive information on the use and construction of cob buildings, regulating authorities are often reluctant to approve its use or, indeed, the use of any form of raw earth construction. It is now an opportune time to examine in more detail the requirements of the Building Regulations and how they apply to new and existing cob buildings.

THE BUILDING REGULATIONS 2000 (AS AMENDED)

Regulation 4
Requirements relating to building work

The requirements of Schedule 1 that are to be addressed in this paper are;

Part A Structure

A1 Loading
A2 Ground Movement

"The building shall be constructed so that the combined dead, imposed and wind loads are sustained and transmitted to the ground, and that ground movement caused by swelling, shrinkage or freezing of the subsoil etc will not impair the stability of any part of the building".

Part A of the Building Regulations deals with the structural adequacy of the building to ensure the safety of people in and around the building. Most commonly used materials and forms of building construction have guidance on their use provided by the Approved Document clauses of the Building Regulations or in the British Standards Codes of Practice and the Eurocodes. Cob does not have such Codes of Practice or guidance in its use but does have the benefit of being a material that has been used for many centuries and providing successful structures that have stood the test of time. However, this alone should not automatically ensure approval under the Building Regulations. Care must be taken to ensure that any building has sufficient load carrying capacity to support its own weight and the loads imposed upon it and it retains its structural stability even when subjected to lateral loading such as from the wind. To ensure this, the building should be arranged such that the walls provide mutual buttressing to each other or that some additional framework is provided to ensure such lateral loading is safely transmitted to the ground.

The compressive strength of cob is low relative to other building materials such as conventional masonry. However, this is compensated for by the greater thickness of wall construction receiving the loading. In the majority of cases, the thickness of wall of 600 mm or more will be adequate for the support of the walls forming a two-storey house. The load capacity of the walls should be checked, particularly where there are concentrations of loads such as under the bearings of floor beams or in any short sections of wall that occupies the space between two large openings.

The strength of cob can vary greatly according to the properties of the subsoil used, the straw content, the degree of compaction and the general quality of the workmanship. It is therefore desirable to obtain information on its load capacity by carrying out tests on samples. In calculating the load capacity of cob walls, an analogy with the methods used for designing masonry construction can be adopted. When tested in the past, samples of cob have provided compressive strength of between 1 and 2 N/mm^2. However, applying the same factors of safety and adjustments as are normally used on masonry construction, the safe permissible stresses used for calculating the strength of a wall would normally lie between 0.1 to 0.2 mm N/mm^2, depending upon the material used and the quality of the workmanship that is expected to be used in its construction. So with some engineering knowledge and information of the material to be used, together with the precedents of its past use, it can be shown that cob can provide a safe viable load-bearing wall construction.

Where existing buildings are to be adapted for new uses and therefore required to meet the needs of the Building Regulations, the same principle can be adopted and provided that any damage is repaired and the integrity of the structure as a whole is retained or re-established, i.e. by stitching and repairing cracks etc., there should be no particular reason why the existing cob walls cannot be used as the load-bearing elements for the building's new use.

As with all other buildings, cob walls should be provided with adequate foundations so that the loads of the building are safely carried by the underlying subsoil. The main difference will be that for a similar sized building, the overall weight of the walls are greater and therefore may require a wider foundation. However, as the thickness of the walls is substantially more than a typical wall construction, this is usually catered for by a foundation which projects 100 mm out from each face of the wall construction.

It is necessary to ensure that the cob is not affected by damp conditions rising from the ground. For this reason, any new wall construction should be provided with a damp proof course and the wall construction below this should be able to maintain its strength in damp conditions. It is therefore usually necessary to provide a masonry base to the wall between the underside of the cob and the top of the foundations. This masonry base or plinth, sometimes referred to as pinning, does not always need to be built in solid construction throughout its thickness and can be formed with a cellular construction or a series of leaves of masonry such that the voids in between can be filled with insulation to minimise the degree of thermal conductivity through this section of the wall construction.

Where existing walls are retained as part of a building where the use has changed, some assurance should be obtained that the foundations are on a sound bearing strata and the condition of the masonry below the cob is structurally sound and also adequate to support the load above. As an existing building will have stood for some time prior to its adaptation to its new use, it will have the advantage of having pre-tested the ground conditions and any inadequacies will be shown in damage or deformation of the wall construction.

Part B Fire Safety

B2 Internal Fire Spread (linings)

B3 Internal Fire Spread (structure)

"To inhibit the spread of fire within the building, the linings shall adequately resist the spread of flame over their surfaces and have, if ignited, a rate of heat release which is reasonable"

"The building shall be designed and constructed so that, in the event of fire, its stability will be maintained for a reasonable period"

Byelaws before 1953 required that certain walls such as separating walls should be constructed of non-combustible material throughout and have a fire resistance of one hour. Because the majority of cob is earth mixed with straw it cannot be classified as non-combustible throughout, for this reason cob was not looked on favourably.

Cob will have varying amounts of straw from under 1% to 3% dry weight (average 1.5 to 2%). Some North Devon cob has very little if any straw but has an added shillet content, which performs a similar binding function but is non-combustible.

The 1965 Building Regulations referred to fire resistance but withdrew the non-combustibility requirement from small buildings such as dwellings. This is currently the case in the 1991 Building Regulations. These Regulations define non combustible materials as those comprising totally inorganic material, or plaster or masonry containing not more than 1% by weight or volume of organic testing as being of limited combustibility. Under these definitions it would appear that some cob could be classified as non-combustible and some of limited combustibility.

None of the old Byelaws or early Regulations listed cob or similar constructions and gave them a fire rating. Experience has shown that cob walls do resist the effects of fire. Collapse of cob has occurred during a fire, the cause of which usually relates to unprotected timbers within the wall failing or the cob being totally saturated by applied water resulting in rapid cooling which causes cracks allowing moisture penetration. This can reduce the material to a plastic state at which point internal cohesion is lost and collapse will occur.

It is necessary to draw comparison with other materials to obtain a reasonable assessment of fire resistance, as appropriate testing has not been done. Brick walls 200mm thick have been assessed as having 6 hours fire resistance, whilst concrete blocks 100mm thick 2 hours and 75mm wood wool slabs plastered both sides 2 hours.[8] It is more than reasonable to consider that 400mm to 600mm of cob has a fire resistance of 2 hours.

Cob walls are generally thick enough to provide all the fire resistance required but there may be defects or openings that have to be repaired to complete the fire resisting integrity of the wall. This is important in that a fire will tend to shrink cob which then enlarges any small cracks and fissures thus enabling the fire to penetrate, creating unseen fire travel, smoke spread and weakening of the structure. Walls that are to be separating walls between two dwellings will need to be extended into the roof space to provide adequate fire resistance and sound insulation.

Part C Site preparation and resistance to moisture.

C2 Resistance to Moisture

"The walls, floors and roof of the building shall adequately protect the building and people who use the building from harmful effects caused by ground moisture, precipitation and wind driven spray, condensation, and spillage of water from fixed appliances".

Dampness in a building can have a detrimental effect on the health of the occupants. Dampness in walls also has a disturbing effect on the decorative finishes and is visually unattractive. Excessive levels of moisture in the base of a cob wall can lead to structural failure. Compliance with this requirement is relatively easy by simply installing a damp proof course in the masonry base wall and linking this with the damp proof membrane of a solid floor or, if a suspended floor is employed, locating the damp course in an alternative suitable location.

Where the cob wall has been weathered badly it may be desirable to render the wall externally to restrict further deterioration and provide an external decorative coating. External renders should be lime-based as recommended in the Devon Earth Building Association leaflet on Renders for Cob.

Existing walls will usually have a stone base and can be affected by both rising and penetrating dampness. This dampness has to be reduced so as to provide a healthy internal environment.

Cob, if it becomes too wet, will collapse. It is not essential to keep a cob wall damp to maintain its structural stability as argued by some. The Building Research Establishment advises that a moisture content of between 3 and 5% at the base of a cob wall is quite normal. However, moisture levels in excess of 7½ to 10%, depending on soil type, could indicate the presence of rising damp.

In most buildings any adverse levels of dampness should be contained in the stone plinth walls and without suitable treatment this dampness may migrate to the cob via any new internal plastering.

The damp treatment must always be carried out in the stone plinth wall. A chemical injection system should never be inserted into the cob as a concentrated amount of liquid at the base of the cob may induce structural collapse. Methods using a system of tanking should be avoided, as there is the likelihood of forcing the moisture to rise above the stone plinth wall into the cob.

Part E Resistance to the passage of sound

E1 Protection against sound from other parts of the building and adjoining buildings

E2 Protection against sound within a dwelling-house etc

"Dwelling houses shall be designed and constructed in such a way that they provide reasonable resistance to sound from other parts of the same building and from adjoining buildings"

Cob used in the construction of semi-detached or terraced dwellings will need to have adequate performance in this respect.

Resistance to airborne sound depends mainly on the mass of the wall. Brick walls 215mm thick having an overall mass of 375kg/m^2, concrete block 215mm at 415kg/m^2, concrete in situ having a minimum density of 1500kg/m^3 providing a mass of 415kg/m^2 are considered suitable to achieve this. Cob, by comparison, having a density of 1900kg/m^3 will give a mass of 855kg/ m^2 for a 450mm thick wall and 1140kg/ m^2 for a 600mm wall. This is well in excess of the minimum recommended construction.

Where floors are built into cob separating walls consideration has to be given to the effect of flanking sound transmission and again cob walling far exceeds the minimum recommended mass of 375kg/ m^2 necessary to achieve this standard.

Cob walls have no problems in providing a satisfactory standard but in the case of existing buildings consideration needs to be given to ensuring that rat runs have not seriously reduced the mass of the wall, and that any other structural defects such as cracks are made good.

Part L Conservation of fuel and power.

L1 A In new dwellings
L1 B In existing dwellings

"Reasonable provision shall be made for the conservation of fuel and power in buildings"

For the purposes of L1, unbaked earth will be examined under two separate conditions; firstly in its natural state as traditional cob walling, and secondly with the addition of an insulated internal timber frame.

Unbaked earth walling
Where a new dwelling is erected, it shall not exceed the target CO_2 emission rate for the building, (Regulation 17C, The Building Regulations 2000 as amended), based upon the Government's Standard Assessment Procedure for Energy Rating of Dwellings, SAP 2005 edition.

In the Secretary of State's view, compliance with Part L and Regulation 17C would be demonstrated by meeting the five criteria set out in the Approved Document to Part L.

It is Criterion 1, which requires that the predicted rate of CO_2 emissions from the dwelling (DER) is not greater than the Target Emission Rate (TER), that will prove the most important aspect of the revised requirements to comply with.

Before examining how cob can satisfy L1, perhaps we should consider the 'bigger picture' of what this requirement is aiming to achieve. Clearly, by adopting CO_2 emissions as the benchmark for acceptability of a dwelling design, there should be a case for considering its carbon footprint.

For example, whilst a typical new dwelling having walls constructed of masonry and high performance insulants, will achieve acceptable limiting U values, the dwelling emission rate does not take into account the CO_2 used in the material production and transportation.

Locally sourced subsoil for use in cob walled construction will result in minimal $C0_2$ emissions from extraction to placement on the wall – SAP 2005 does not take this into account when determining the Dwelling Emission Rate.

In addition, Cob has excellent thermal mass properties, which means that it can absorb the heat of a sunny day both directly from the sun's rays, and indirectly from the warm air, Weismann. This heat will be stored within the thermal mass and slowly released into the inside space once the temperatures drop

The School of Civil Engineering at the University of Plymouth has assessed the storage capacity of unbaked earth and other sustainable forms of earth walling using it's time-dependent thermal properties like the admittance and decrement factors described in "Energy and Buildings" from research undertaken by Steven Goodhew and Richard Griffiths.

This research compares both the steady-state thermal transmittance (U-value) of earth walling, and the time-dependent thermal properties using Hevacomp Ltd software.

Results indicate that the time-dependent performance of earth walls is superior to 'standard' dwelling designs, and suggests that more sophisticated studies should be carried out using the Environmental Design Solutions "Thermal Analysis Software".

Keefe expands the issue of Thermal Inertia by stating that although soil has a lower thermal capacity than other heavier materials, its ability to store heat is nevertheless excellent [because] soil benefits from a latent inertia related to its absorption capacity.

This property, which is sometimes referred to as thermal inertia is however, not something that the Building Regulations take into account; the principal factor applied in assessment of the thermal performance of natural materials being thermal conductivity based upon measured dry density.

The study undertaken by Plymouth University, Centre for Earthen Architecture in respect of the thermal performance of unbaked earth walls has provided U-values for 600mm wide cob of 0.66 $W/m^2 K$, and 0.55 $W/m^2 K$ where the wall is rendered with appropriate plasters and renders.

The ability of the other elements in the envelope of a cob dwelling to satisfy both the limiting U-value standards in Table 2 of L1A for Criterion 2 and as part of the TER within Criterion 1 are not considered in this document as the roof, floors and windows can be constructed in accordance with current technical and robust detailing to satisfy L1A.

To determine the ability of cob to satisfy L1A, SAP 2005 assessments were undertaken by a Senior Building Control Surveyor, Maurizio Assante, at Exeter City Council in 2007.

By adopting a renewable energy source, for the purposes of this SAP assessment a Ground Source Heat Pump (GSHP), a DER below the TER can be achieved using un-modified cob at 0.60 $W/m^2 K$.

The resultant DER is achieved due to the efficiency of the main heating system at 320%, compensating for the additional fabric heat loss through the cob wall. Whilst this satisfies Criterion 1, the SAP checklist will indicate a design failure due to the indicated area-weighted average U-value for the purposes of Criterion 2.

Table 2 within L1A indicates that the wall element should not exceed 0.35 $W/m^2 K$, with a limiting U-value of 0.70 $W/m^2 K$. Whilst research indicates that 0.60 $W/m^2 K$ can be achieved, the limits within Criterion 2 are intended to place limits on design flexibility to discourage excessive and inappropriate trade-off, eg: buildings with poor insulation standards offset by renewable energy systems with uncertain service lives.

Indeed paragraph 35 of AD L1A states that it would not be appropriate to allow large renewable energy systems to completely compensate for a poor envelope.

It would ultimately be the decision of the BCB to resolve whether satisfying Criterion 1 in respect of the DER/TER is acceptable for the purposes of discharging the requirement of L1, having regard to the issues relating to the use of a GSHP.

In the opinion of DEBA, the issue with regard to Part L is one of $C0_2$ emissions. Renewable energy sources are widely acknowledged as having significant advantages over fossil fuel sources heating systems, and as such, we feel the commentary in paragraph 35 of AD L1A fails to offer support that should be afforded to the use of unbaked earth in residential construction.

Future developments of Part L of The Building Regulations will lead to Zero Carbon homes being a requirement by 2016. Promotion of unbaked earth will provide a valuable procurement route to achieve this goal.

Applications for new dwellings deposited on or after the 6th April 2008 will require an Energy Performance Certificate (EPC) for completion under the Building Regulations as amended.

The use of internal Insulation

Where BCBs are reluctant to accept the opinions above, there is the opportunity of provide an insulated internal timber frame dry lining to provide an overall U value to satisfy the Criterion in L1A, a range of applications have recently been tested and published in “Energy and Buildings”.

A range of sustainable insulants are available for use in an internal dry-lining application to improve the external wall element U-value to current guidelines, however, this form of construction is often frowned upon by earth build traditionalists.

Currently, English Heritage views the technical risks as unacceptable and does not recommend insulating earth walled houses either internally or externally.

MATERIAL ALTERATIONS
Regulation 3

The 'meaning of building work' defined in Regulation 3 contains eight definitions which includes in para (1) (c), the 'material alteration of a building'. An alteration is material for the purposes of the regulations if the work would at any stage result in a building not complying with a relevant requirement, or, where before the work commenced did not comply, being more unsatisfactory in relation to such a requirement.

Relevant requirements;

Part	**A:**	**Structure**
Part	**B1:**	**Means of warning and escape**
	B3:	**Internal Fire Spread - Structure**
	B4:	**External Fire Spread**
	B5:	**Access for Fire Fighting**
Part	**M:**	**Access to and use of buildings**

Where a building previously complied with any of the above Regulations, then any alterations to the building must also comply. Where the building does not already comply with any of the above then the alteration must be carried out in a manner that does not make the contravention more unsatisfactory.

EXTENSIONS

Extensions to a building must comply with all the relevant Regulations. As far as cob walling is concerned this is as set out for new building with the exception that guidance relating to the Conservation of Fuel & Power is obtained in Approved Document L1B, rather than L1A, and the production of a SAP 2005 rating is not a statutory requirement.

Section 1 of the Approved Document to L1B indicates three approaches on how the requirement can be met;

(1) Using fabric U-values form Table 4, with restrictions on the area of glazing (25% of the floor area) together with limits on controlled fittings. To use this approach, where the maximum U-value should not exceed 0.30 for the wall, an insulated internal stud wall will be required to increase the performance of the cob.

(2) Where greater flexibility is required, a way of complying would be to show that the area-weighted U-value of all the elements is no greater than that of an extension of the same size and shape that procedure (1) above.

The area-weighted U-value for each element type should be no worse than the value in column (a) of Table 1 – for walls 0.35, and the U-value of any individual element should be no worse than the limiting U-value in column (b) – in this case 0.70.

(3) The third indicated method to demonstrate compliance is to use SAP 2005 to show that the calculated $C0_2$ emission rate from the dwelling with its proposed extension is no greater than for the dwelling plus a notional extension built to the standards in procedure (1) above.

MATERIAL CHANGE OF USE
Meaning: Regulation 5
Requirements: Regulation 6

Many cob buildings used for purposes exempted from control have been converted to a use that is now controlled. In this situation the Building Regulations are applied both to the existing structure and to any new services and other building work, eg: converting agricultural buildings to dwellings. In such cases the following Regulations would apply to the existing cob walls: -

B1 – 5	**Fire safety**
C2	**Condensation**
F1	**Ventilation**
G1 – 2	**Hygiene**
H1 & 6	**Drainage & solid waste storage**
J1 – 3	**Heat producing appliances**
L1	**Conservation of fuel & power**
P1	**Electrical safety**

MATERIALS AND WORKMANSHIP
Regulation 7

This Regulation seeks to ensure that any building work is carried out with proper materials, which are appropriate in the circumstances in which they are used and put together in a workmanlike manner. The Regulation recognises that there are ways of establishing what is a "proper material" or "workmanship" and makes specific reference to approved testing bodies.

These include materials with (i) an EC Mark, (ii) conform to an appropriate European technical approval or harmonized standard, (iii) a British Standard or British Board of Agreement (BBA) Certificate, (iv) to national technical standard of any member state comparable to BS or BBA. However, specifying these standards does not exclude any material that can be shown by test, calculation or other means that it is capable of performing its designed function.

Tests, of course, should be carried out by independent accredited testing laboratories. "Other means" allows past experience to be relevant and it is on this basis that cob can be accepted, so that by reference to a building in use constructed of cob a new building constructed in a similar manner may be acceptable. Whilst this comparison is not limited to area or regions, as far as cob is concerned it must have some local relationship.

Obviously if a new cob building is proposed to be constructed close to existing cob buildings it is reasonably safe to assume that local soils are suitable. In other parts of the country where cob buildings have not traditionally been constructed, it is essential to establish the suitability of the sub-soil.

Likewise with workmanship, as there is no British Standard Code of practice relating to the construction of cob, it is essential that those involved in the preparation and construction have a good understanding and practical experience of working with this material so as to ensure that past experience can be a basis of acceptance.

During the course of construction the Local Authority Building Control have the power to take samples of the material and carry out any tests they may feel appropriate. Cob, using suitable soils, adequately mixed and prepared, applied in a proper manner, can satisfy Building Regulation 7.

LOCAL AUTHORITY BUILDING CONTROL SYSTEM APPROVAL

There are ranges of internal and external insulated applications that can be used with traditional cob walling to improve the U value of the wall element without prejudice to the natural material.

In seeking LABC System Approval for cob, it is proposed that two applications will be made;

(1) Cob with an internal insulated timber frame, and

(2) Traditional cob

COB BUILDINGS. THE DEVON MODEL

The successful application for a LABC System Approval will form the basis of the submission to the Department of Communities and Local Government to enable 'COB BUILDINGS. THE DEVON MODEL', to be included within the Approved Documents to the Building Regulations 2000, under 'Other publications referred to'.

The 'model' will give practical guidance to BCBs on how cob construction satisfies the functional requirements of Schedule 1 to The Building Regulations.

CONCLUSIONS

New and existing cob walled buildings can be constructed, altered, extended or changed in use, so as to comply with the Building Regulations. It is essential to incorporate the aims of the Regulations as early as possible into the design process thereby avoiding conflicting needs at a later stage.

Further advice can be obtained from the Devon Earth Building Association, or any of the ten Local Authorities in Devon. The Association is willing to give advice on cob buildings outside the County of Devon; however, the interpretation and application of the Building Regulations remain the responsibility of the chosen BCB.

READING LIST:

Goodhew S & Griffiths R	Sustainable earth walls to meet the Building Regulations. Energy in Buildings 37 (5) p451-459, May 2005.
Harrison R	Earth, The Conservation and Repair of Bowhill, Exeter – English Heritage, London 1999.
Hurd J & Gourley B	Terra Britannica, James and James, London 2000.
Keefe L	Earth Building: Methods and Materials, Repair and Conservation. Taylor & Francis, Abingdon 2005.
McCann J	Cob and Cob Buildings, Shire Publications Ltd., Princes Risborough, 1995.
Schofield J & Smallcombe J	Cob Buildings: A Practical Guide, Black Dog Press 2004.

Devon Earth Building Association and Devon Historic Buildings Trust Guidance Leaflets are available on the DEBA website: www.devonearthbuilding.com.

GLOSSARY

ADOBE
The construction of buildings using sun-dried earth bricks, either hand shaped or formed in pre-made moulds.

BCBs
Building control bodies

BINDING FORCE
The tensile strength of a material in a plastic consistency.

CARBON FOOTPRINT
A Carbon Footprint is the measure given to the amount of green house gases produced by burning fossil fuels, measured in units of carbon dioxide

CFC'S
Stable, non-toxic and non-flammable gas compounds known as Chlorofluorocarbons.

CIBSE
The Chartered Institute of Building Services Engineers.

COB
The construction of buildings by placing successive layers of intermixed wetted earth and straw upon a stone plinth without the use of shuttering.

COMPRESSIVE STRENGTH
The measure of the ability of a material to resist compressive forces.

CLG
Communities and Local Government

DER
Dwelling emission rate of $C0_2/m^2$ (SAP 2005)

DOE
Department of the Environment

GSHP
Ground Source Heat Pump

HYGROSCOPICITY
The ability of a material to absorb moisture from the air.

ICOMOS
The International Council on Monuments and Sites.

PAIRING
'Chopping-back' excess cob with a pairing iron to ensure verticality of the wall face.

PINNING
A stone plinth, usually extending 600mm from ground level, supporting the unbaked earth walling.

PLASTIC LIMIT
A measure of the minimum moisture content at which a clay retains its 'plastic' properties and does not break up when moulded.

PLASTICISER
A substance that produces or promotes plasticity.

LIQUID LIMIT
A measure of the minimum moisture contents at which a clay looses its 'plastic' properties and begins to flow.

MOISTURE CONTENT
A measure of the amount of moisture contained in a sample of soil from measurements made before and after drying at a temperature of 150^{o}C; expressed in gravimetric (as a percentage of residual weight after drying) terms.

SAP 2005
The Government's Standard Assessment Procedure for Energy Rating of dwellings. Defra 2005.

SHILLET
A term used to describe weathered shale.

STABILISED EARTH
An earth compound benefiting from the addition of a stabiliser, i.e.: cement.

TENSILE STRENGTH
A measure of the ability of a material to resist tensile forces.

TER
Target emission rate of $C0_2/m^2$ (SAP 2005)

ZERO CARBON HOME
A zero carbon home is one that generates as much power as it uses over the course of a year and therefore has net zero carbon dioxide emissions

AIMS AND OBJECTIVES OF THE DEVON EARTH BUILDING ASSOCIATION

To provide a forum for the discussion of issues relating to earth building in Devon and the South-West of England.

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 or 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 the material for low-energy ‘appropriate technology’ building.

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Bagenal, Hope: Country Life. 19th December 1947. ‘It should not be forgotten that in many parts of England, part of the bridegroom’s job was to build a cob house for his bride’