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The cob building technique. Past, present and future

La técnica constructiva del cob. *Pasado, presente y futuro*

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SUMMARY

Cob, an ancient earth building technique has given rise to hundreds of thousand buildings across Europe for centuries. It has a very distinct appearance of substantial organic walls punctuated with small apertures whose windows and doors are set back to create deep reveals. Traditionally protected by thatched roofs, these vernacular buildings make an important contribution to local identity. Cob buildings still survive and continue to be occupied in many European countries including France, Italy, Germany, Belgium, Czech Republic and England (1). Following a description of the cob technique, this paper will present a brief overview of the history of cob in Devon, a county in South West England. Recent English cob buildings will be introduced with a discussion of the potential of this earth building technique for future architecture.

113.101

Keywords: earthen architecture, cob building technique, traditional skills, building conservation, sustainable building construction material.

RESUMEN

A través de Europa, cientos de miles de edificios han sido construidos por un método de construcción antiguo, el uso del cob. *Estos edificios tienen una apariencia característica de muros orgánicos salpicados con pequeñas aperturas cuyas puertas y ventanas se rehunden para crear profundos relieves. Tradicionalmente protegidos por techos de paja, en estos edificios vernáculos está una parte importante de la identidad local. En muchos países europeos todavía se encuentran edificios hechos de cob, como Francia, Italia, Alemania, Bélgica, República Checa, e Inglaterra (1). Después de una descripción sobre el uso de* cob, *este artículo presentará una historia breve del uso de cob en Devon, una región en el suroeste de Inglaterra. También introducirá ejemplos de edificios modernos de cob, con una discusión sobre el potencial de usar este método de construcción en proyectos arquitectónicos en el futuro.*

Palabras clave*: arquitectura con tierra, técnica constructiva* cob, *habilidades tradicionales, conservación de edificios, material de construcción sostenible.*

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1. Mixing Cob

2. Mixing by Tractor

1. THE COB TECHNIQUE

Cob is a building technique whereby excavated subsoil, the layer of material below the organic top soil and above the bedrock, is mixed on the ground and then placed on to a wall to produce a monolithic, load bearing structure. Although this technique is referred to as cob in Devon, different names have been given to this technique in other areas of Britain, including *clob*, the term used in the English county of Cornwall, *witchert* in Buckinghamshire, *mud walling* in the Midlands, *clay dab* in Scotland (2) and *clom* throughout Wales (3). In France *bauge* describes the cob technique, in Germany *weller* and in Italian cob is called *terre crue* (4).

British subsoils vary from one location to another in terms of both their constituents and their proportions. A variety of these subsoils have been used to manufacture cob for traditional buildings with the skills of the builder likely to have been able to assess suitability. Recent research has shown that in most cases the subsoil was taken directly from the site, where wall foundations, basements or ponds were dug, although traditional builders appear to know the optimum mix well enough to select subsoil from nearby pits (5). Today materials from a number of nearby locations are can be mixed to provide what has been agreed to be the optimum building material e.g. by Kevin McCabe for Kepple Gate. Today these variations must be also understood to determine the viability for manufacturing cob; to predict its performance; to develop appropriate conservation techniques and achieve new buildings; and to gain the statutory building permissions (6).

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Current knowledge of the technique shows that the subsoil must be thoroughly mixed in order that its constituents are evenly distributed throughout the mixture (Figure 1). There is agreement that the aggregates within this mix should be well graded with the largest, 50 mm diameter gravel, through fine gravels and sands to silts. The sand occupies the voids between the gravel, and silt, finer still, fills any remaining gaps. However to ensure cohesion a binder is required and this is the role of the clay present within the soil. It is believed that a good mix for cob construction is 30-40% gravel, 25-30% sand, 10-20% silt and 10-25% clay (7). This has been established through the characterisation of material taken from existing cob walls which survive in good condition. In other counties of England chalk rich soil has also been used to manufacture traditional cob buildings (8). The most comprehensive explanation of cob manufacture has been recorded by Laurence Keefe in his recent book, Earth Building (9).

Cob can be described as a wet earth building technique. This makes it appropriate for the Devon subsoils which are inherently wet due to the region's high rainfall. More water is also added to the subsoil to facilitate the mixing, as its addition slurries the clay to ensure it coats the aggregate (10). Today the volume added to manufacture cob varies with quantity already present in the soil and the builder, some builders preferring to add large amounts and then allow the material to dry before being placed on the wall, whilst others prefer a drier mix from the outset to avoid the delay. Familiarity of the ideal constituency developed through practical experience is the critical to the ultimate success of the wall. Laboratory testing at the University of Plymouth shows the initial cob mix to be between 18 and 25% by volume (11).

The majority of water added to the mix will evaporate during the drying process making it impossible to establish the volume of water added by our ancestors. Although the wall will never become completely dry. Peter Trotman has shown that the hygroscopic moisture content caused by salts within the wall varies but always means a low level of moisture is present (12). The internal and external relative humidity will also affect the amount of moisture in the wall with porous finishes (13).

The addition of fibrous materials is generally associated with the cob building technique, although cob walls free of fibre have been found very occasionally. Fibre generally takes the form of barley straw, but other materials have been identified including wheat, oats,

animal hair, heather, moss, chopped rushes, hay, coarse grass, twigs, furze, flax, sedge, twitch, grass and cow parsley (14) Experts agree that the role of fibre is very important to ensure the material dries evenly thereby avoiding large shrinkage cracks. The addition of fibre also helps in the mixing process and may assist in the structural and thermal performance of the wall (15).

Mixing sufficient material can be a back breaking process unless assistance can be given by animals or machinery. The former is described by Reverend Copinger Hill in a prize winning essay in the Journal of the Royal Agricultural Society, 1843.

"The clay and chalk are raised and carted to a convenient spot of hard ground where they are beaten to pieces by a heavy prong, and stones picked out, and formed into a circular bed one foot thick and 20 feet in diameter (300 mm by 6 metres). The bed is well watered, and trodden by horses; and while trodden, one man shakes short straw upon it with a fork, while another pulls it about with a prong, and throws the outside portions under the feet of the horses, and supplies a sufficiency of water. It can hardly be too much trodden." (16)

Recently this has been demonstrated successfully by Alfred Howard who has mixed large quantities of cob using cattle who also have cloven hoofs. Kevin McCabe uses a tractor although this requires the addition of considerable moisture with a resultant very wet mix which needs to dry (Figure 2). Once a suitable mix has been achieved it can be placed directly onto the wall. It is normal to build an earth wall on a plinth of masonry which might be built from the larger stones removed from the subsoil. Very occasionally walls built without plinths have been identified. The height of the plinth varies from 450mm to an entire floor. The plinth lifts the cob above rising damp and splashes of rain dripping from the roof. In Devon cob is also found in a narrow band high up on masonry walls. Perhaps this was done to increase wall heights when roofs were lifted to incorporate upper floors in what were once single storey buildings. Another theory is that it was easier to build with cob than stone around the timber roof structure. Some walls are a patchwork of cob and stone masonry with little obvious rationale determining the choice apart from what was at hand. The width too of the plinth and subsequent earth wall also varies, although it is always substantial. Early cob walls are generally up to 900 mm thick, a generous dimension which gives the protective character to the vernacular buildings made from this technique. Later wall thickness decrease to 600 mm or less to achieve the fashionable 'polite' architectural styles of C18 & C19 Britain (17).

Cob building took place in Devon in the late spring and summer months when the weather was relatively dry. Alfred Howard's reference to the saying 'Cob should only be built when the swallows are here', is good advice. To build when the weather is cold and wet is not good practice. Traditional builders are also likely to have used the effects of the winter frosts to break up very clayey subsoils prior to manufacture the following spring (18). It was possible for walls to reach full height in one season so the roof could be constructed before the following winter (19).

It is likely that traditional cob wallers worked in teams of at least two, and were often farm labourers who built as part of their annual cycle of work, as was recalled by Alfred Howard. The wet material was lifted on forks usually those for hay pitching or purpose made by blacksmiths (20). Once the cob was placed on the wall it was compacted by the weight of a person standing on the wall who exerted vertical and horizontal pressure through knocking the side of the wall with the heel of the foot (Figure 3). Experience has shown that the need to support its builder may help explain the wall's generous width. It was important that the cob initially overhung the external face of the plinth. This work was continuous until one lift had been achieved whose height varies possibly as a consequence of wetness of mix and subsequent structural stability; availability of manufactured material and labourers' time; the weather; and tradition. The lift was protected from rain by a layer of straw whilst it dried (21). The amount of time for this process to be completed varied according to climate and wetness of mix. However it was vital that the previous mix was almost dry before a further lift could proceed.

Whilst this technique achieves a monolithic load bearing wall, it differs from that of rammed earth, in that the wall is built without shuttering, the mix is much wetter and includes fibres (22). The skills of the builders would allow a reasonable finish without shuttering, although paring down of both sides took place with a variety of implements including axes and mattocks (23) to achieve a flat vertical surface often on the line of the

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3. Placing the cob

4. Lyon House Main Entrance

plinth. In the absence of shuttering, practical experience and observation shows that the walls are better constructed without sharp arrises at corners or apertures. Instead the curved junctions together with the reliance on a pared finishing of the surfaces give cob buildings their visual distinctiveness. Their appearance is organic, handmade and unique. It can be much enjoyed in contrast to the clean, crisp, machine made building components currently employed in contemporary construction (Figure 4).

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The construction of apertures in cob walls presented no problems, provided lintels were available to support the loads above the openings. Generally a pair of timber lintels were used with generous bearings onto the walls either side. Windows and doors could be fixed by either manufacturing their frames with projecting fixing blocks, cast into the walls during the construction process and thereby providing a permanent shuttering for the opening. Alternatively fixing blocks might be cast into the wall and the frames fixed later in the building process. Timber fillets may also be built into the wall to allow the fixing of joinery elements including skirting boards and picture rails (24). Likewise the timbers of the upper floors and roof structure can be built into the earth walls. The form of the roof generally avoids the use of gable walls because their diagonal profile made them difficult to construct using the cob technique. Instead hipped and half-hipped roofs provided an excellent solution. Although cob walls in the Abruzzo region of Italy, can be seen extended into gables using adobe bricks to create a pitched roof. Traditionally the roof finish was thatch, complementing the organic nature of the walls and through constructional necessity, creating wide eaves, so vital in the protection of the wall surface from the high rainfall. It is the change of roof finishes to tiles or sheeting on cob properties with the resultant slender eaves' overhang which limits their protection and can lead to the deterioration of cob walls.

In addition to the protection given by the roof, cob walls were usually given both an external and internal finish. This finish may be an earth based material, whereby sieved earth is mixed with animal hair or fine straw. If lime was available this was used often as a final layer of limewash. Annual reapplications continue to give the distinctive white colouring so frequently associated with cob today (25). Both clay and lime based renders were fixed directly onto the surface of wall, possibly after that surface had been wetted to ensure satisfactory cohesion. Both the earth in the wall and the earth or lime renders are porous and allow the walls to breath. The importance of this is still not fully understood or scientifically studied. It was common practice in the twentieth century to replace original sympathetic finishes with impervious cement based products frequently necessitating a mechanical key for adhesion. Observations of damp, damaged or collapsed cob walls show cement renders to be the likely cause of this deterioration. So too plastic based finishes, such as paints will also inhibit the walls ability to breath. The lesson learnt from this has meant a move back to the use of lime based renders with earth renders used less frequently nowadays (26).

The ancient technique to manufacture cob and construct a wall appears to have changed little over its long history. This has been shown principally through observation and analysis of existing buildings and developing an understanding of the technique through practical experience gained from the knowledge of a very few farmers who continued the technique to keep their cob farmsteads in good repair. Documentary evidence of the construction technique in the past is very limited and usually only records the existence of the material (27) and not the manufacturing process. This was probably because the dwellings of common people were unworthy of comment (28). However as introduced above in 1843 Reverend Copinger Hill was very thorough in his descriptions.

"A pinning (a plinth wall) of stonework 14 inches (350 mm) thick and one foot (300 mm) out of the ground is prepared. One man gets upon the pinning with a small three-pronged fork; his partner throws up to him small lumps of clay, the size of a double-fist, which he adroitly catches on the fork , and deposits smartly on the wall, walking backwards. A height of 20 inches or 2 feet (500-600 mm) is built at one time; at intervals as the work proceeds the workmen coax the sides of the wall with spades and make it straight. It is then left to dry for a few days, or longer; all depends on the weather" (29).

Recent research of a late eighteenth century local Devon building firm collaborates Copinger's description and confirms the seasonal nature of the material together with its comparative costs in construction projects (30).

Recent practical experience of a number of educational training sessions has shown the technique to be very labour intensive, dirty and restricted by the seasons. Although most who participate in these cob building training sessions enjoy the experience and benefit from the team work required to practice the technique. Unlike many contemporary construction processes participants find the "low tech" characteristics of cob easy to understand and to achieve successful outcomes. Its very distinct handmade architectural language speaks of its manufacture and the people who have undertaken the build. Some find this very satisfying others just like the exercise and camaraderie.

2. THE GEOGRAPHICAL DISTRIBUTION OF COB BUILDINGS

The geographical occurrence of surviving earth buildings is beginning to be known although there is no comprehensive inventory in terms of historical and architectural development, quantity or precise geographical distribution. This would be no easy task. Firstly a precise definition of a cob building would need to be agreed. How much cob would need to be present in a building would provide an important determinant. Cob can be one of a number of walling materials in a single building, but if it is the major material this could be sufficient (31). Cob used as a walling material is almost always concealed by protective coverings of renders, panels or even outer leaves of brick or stone in England. This makes the visual identification difficult. Especially so as many stone walled buildings are also rendered and in some cases share the same overall visual architectural characteristics as cob. Academics and practitioners are in agreement that the majority of cob buildings are in South West England. This would comprise the counties of Devon, Cornwall, Somerset and Dorset. Smaller pockets of cob occur in other parts of Britain such as in the Midlands' counties of Leicestershire, Northamptonshire and Warwickshire (32). The pattern could be anticipated as the country has a varied geology. Where good building stone was readily available this was used by indigenous builders to create architecture closely related to its geographical location. In other areas where there was little stone available local subsoil provided a building material to be used in a number of ways including the manufacture of cob. This too created the building's bond with site and surroundings.

Although this has not been the focus of any comprehensive academic study, this pattern could be similar across Europe, recognising that where subsoils vary different earth construction techniques could have been employed e.g. Rhone Alps which utilises the rammed earth technique.

A notable use of the cob technique is in the English county of Buckinghamshire where a group of villages utilised this technique, although the term witchert, meaning white earth, describes the cob walls made from the locally occurring lime rich sub soil. Again the material was consistently used on many building types until the twentieth century creating a visual cohesion and giving a strong identity to these settlements. Of the group, Haddenham displays the most exquisite use of curvilinear boundary walls defining intriguing paths throughout the village. The most interesting of its many witchert buildings is The Bone House, 1807 which is believed to displays witchert making tools in its render decoration (33).

East Anglia can boast a number of earth walling techniques, but the most notable is the use of earth blocks locally referred to as clay lump. This technique was introduced into the region in the 1800s and can be found extensively on the boundaries between the two counties of Norfolk and Suffolk and around Cambridge. Similar to cob the identification of clay lump is difficult as it is rendered or used as an inner leaf with fired brick or flint forming the outer wall surface. Although a few buildings constructed from the cob technique also survive. The use of the cob technique is not surprising as the wet mix is the same as that placed in moulds to manufacture clay lump (34).

The earth building found to the North of East Anglia in Lincolnshire is characterised by the use of relatively slender earth walls similar to those constructed from cob. This is made possible through the use of a technique called

5. Typical ancient cob cottages

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6. Cob Farmhouse, Normandy

7. Devon Cob

8. C19 Houses at Dawlish

9. Students try repair

10. Learning about the strength of cob

mud and stud, where a timber frame is contained with the earth wall. Mud and stud is an ancient construction technique, although nothing representative survives before the seventeenth century. Of the thousands of Lincolnshire earth buildings which survived until the twentieth century, only two hundred remain today, many of which have been faced with brick (35).

Cob is a global earth building technique although again there appears to be no worldwide survey to chart the occurrence of the material. There are known of examples of the cob construction technique in several European regions including Brittany, Lower and Upper Normandy, Vendee, Languedoc-Rousillion, Aquitaine, and Loire Valley in France; Old Castile in Spain; Chieti in Italy; Saxony, Saxony- Anhalt and Thuringia, Germany; and Moravia in the Czech Republic (36).

The Cob Building in Europe conference held in Normandy, France in 2007 was an opportunity for representatives on the cob regions across Europe to exchange knowledge and concerns and has resulted in collaborative working with the possibility of establishing a more formal organisation following an EU INTERREG project currently under preparation.

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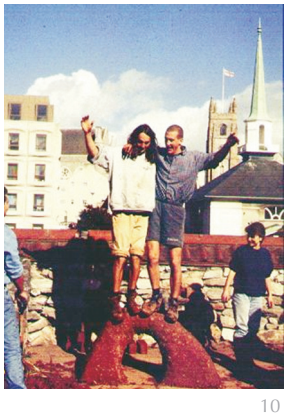

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3. DEVON'S COB BUILDINGS

Cob is the earth construction technique used for the large number of buildings which have survived in the county of Devon. This makes it an important component of Devon's vernacular architecture (Figure 5).The geographical distribution of cob is widespread across Devon, although the precise number has never been quantified. Jo Cox of Keystone Historic Building Consultants, Exeter, found when travelling through this large English county at the end of the last century to assess all buildings for possible statutory protection that it was difficult to find an area free of earth structures. When the varied geology of Devon is taken into consideration, it indicates that some builders used the material occurring locally be it stone or earth while others made a deliberate choice to use the cob techniques .The Devon banks which contain the county's roads and delineate the field boundaries are constructed from earth, whilst many rural farmsteads, hamlets and villages use the cob technique. Some towns too owe much of their current historic building stock to the cob builders of the past.

Earth has occupied a significant position in the palette of Devon's building materials of the last thousand years. Whilst early earth buildings of this period survive infrequently, thousand of earth buildings survive from medieval times through to mid nineteenth century when the coming of the railways brought new building materials to the county together with new construction techniques, architectural styles, fashions and building typologies. It is estimated that at least twenty thousand cob dwellings remain in addition to twenty thousand agricultural buildings (37). Cob appears to be the construction technique for most past building typologies. Dwellings of every size and status, from humble workers' cottages to significant houses of land owners, were achieved from the technique. This widespread use of cob in a variety of dwellings for different social classes could dispel the myth of earth being restricted to the poor. Wealthy cob home owners would have had the choice of building material preferred to have their homes constructed from cob. This demonstrates the possibility of earth being deliberately chosen to achieve the internal comfort conditions that too are beginning to be recognised today. Many farmsteads too use this ubiquitous technique with everything from freestanding yard walls to cow sheds and storage barns of cob. The French farmsteads of the Cotentin and Bessin marshlands of Normandy are almost identical to those of Devon in their use of cob (38) (Figure 6). Public buildings too such as Devon's Sandford Primary School and the chapel at Collumpton can be added to the cob building list. This pattern is similar to the occurrence of earth in other regions, for instance the Rhone Alps of central France where rammed earth has fashioned a wide range of building types and styles.

Most surviving cob buildings remain in continuous occupation. Whilst many remain in their original usage, frequently houses have been modified on many occasions to accommodate different standards of living. Others have undergone changes for instance agricultural buildings have been converted to domestic accommodation e.g. Lower Tricombe by Kevin McCabe. It is testimony to the durability and flexibility of the material that cob buildings still provide useable buildings (Figure 7).

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11. Fun at Mud Days

12. Recent Cornish Cob Annex

13. Keppell Gate

14. Cob House at Cadhay

Whilst it is known that many indigenous builders would have had little choice of materials from which to construct their architecture or knowledge of alternatives, later buildings with clear aesthetic ambitions are nevertheless built from cob. This is demonstrated in some of Devon's late eighteenth and early nineteenth century architecture built in the Georgian and Regency styles. These buildings are particularly difficult to identify as they are always rendered and the use of cob seems unlikely for these periods and styles. A good example is the picturesque villas at Dawlish. This seaside town was popular for visitors wishing to participate in sea bathing (39). However to accommodate the visitors in respectable and fashionable architectural surroundings a building programme was necessary. To achieve these buildings required considerable ingenuity on behalf of the builder because the available walling material was earth. So to achieve the flat surfaces, sharp arrises and overall ordered appearance required, a cob mix was placed in shuttering (Figure 8). This technique is now called shuttered cob and is a hybrid of cob and rammed earth .

These buildings represent a zenith of the cob tradition in Devon. In the mid nineteenth century the railways which brought many more visitors to Devon to enjoy the seaside, also brought building materials and caused the demise of the cob technique.

4. DEVON EARTH BUILDING ASSOCIATION (DEBA)

DEBA is a voluntary group of cob practitioners, professionals and enthusiasts who, initially under the chairmanship of Laurence Keefe, have done much to ensure the survival of the cob technique and its built legacy. This has been achieved in collaboration with the University of Plymouth. Raising public awareness of the technique, understanding building performance and major decay mechanisms, developing appropriate repair techniques and supporting the use of earth in new buildings have been important aims for the group over twenty years. It is due to their success that the cob building stock has survived and is now generally in good condition. Members of the DEBA Working Group have produced a series of guidance pamphlets, now available on their web site, has been important in their mission (40). The pamphlet on Cob and the Building Regulations demonstrates how new cob buildings could obtain the necessary regulatory approvals. Individual members have been responsible for much of the conservation of the existing cob building stock and the limited number of new buildings.

5. UNIVERSITY OF PLYMOUTH CEA

CEA: The Centre for Earthen Architecture comprises a group of multi disciplinary academics whose role has been to undertake research to better understand earth as a building material. Support from several organisations including English Heritage, ICOMOS, CRATerre, ENTPE and the University of Plymouth allowed activities to flourish including the joint hosting of TERRA 2000: *8th International Conference on the Study and Conservation of Earthen Architecture*. Held in Torquay, Devon, delegates from across the world were made aware of our cob heritage.

The knowledge developed from the research programme and collaboration has allowed CEA and DEBA to collectively develop a holistic approach to the cob technique. It has been incorporated into teaching material and for consultancy to support architects to achieve their earth building ambitions. Postgraduate students attending *MA Architectural Conservation* in the University's School of Architecture, Design and Environment benefit from this well developed knowledge base in the module the Conservation of Cob Buildings delivered by DEBA members (Figure 9). The popularity of this module brings in additional participants from across the country, but particularly the South West region to attend the module as a short course. Successful current practitioners began their careers here and now return to lecture on the course.

Practical sessions on the manufacture of cob and its repair, together with more technical sessions including laboratory practicals give a comprehensive knowledge of the cob technique and its conservation. Architecture students also attend lectures on cob and other earth building techniques where consideration is given to the design process when using earth (Figure 10). This has been made possible through staff involvement in

15. Lyon House on River Dart

16. Lyon House

17. Shuttered cob at Merton

18. Shuttered cob house at Merton

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live projects, and in turn students can explore this in their own design projects. Small buildings are regularly constructed with local school children to continue to increase awareness of earth as a building material (Figure 11). The reversible characteristic of earth in building makes it an ideal teaching material. The same material can be used year after year, with no waste. Students are always surprised at how strong their predecessors' structures are made as they require considerable strength to destroy and provide the material with which they will build. Nevertheless they usually very much enjoy the earth building experience.

6. RECENT COB BUILDINGS

The cob construction technique never completely died in Devon. In 1911 Ernest Gimson built an Arts and Craft styled cob house in East Devon and two bungalows were erected from cob nearby a decade later (41). These are the exception. But as long as existing earth buildings survive and remain in occupation they require maintenance and repair, owners and builders will continue the ancient skill. Octogenarian Alfred Howard recalls building with earth in his youth and those recollections allowed him to build the first of the current phase of Devon cob buildings, the bus shelter at the village of Down St. Mary, Mid Devon in 1970. A similar shelter followed at the nearby village of Trusham. These modest structures were important as they demonstrated the cob technique could still be practiced and used in contemporary buildings. His substantial cob extension to Bushels Cottage, Down St. Mary was visited by many professionals and practitioners keen to learn about the cob technique. Laurence Keefe supervised the building of another modest building, a small shelter at the coast village of Starcross, East Devon in 1989. Very near the main Plymouth London railway line, it is seen by thousands of passengers. Although few will know of its construction materials as it, like most cob buildings, is rendered with lime. Jill Smallcombe and Jackie Abey have designed and built several innovative cob sculptures and small buildings exploring the sculptural potential of the material. These include a summerhouse for the National Trust at Broadclyst, near Exeter; the Earth Pavilion at the Genesis Project, Taunton, Somerset; and a toilet and bus shelter for the Eden Project, St. Austell, Cornwall. In West Cornwall, where it is also a tradition technique, builder Matthew Robinson and Cob in Cornwall has constructed several cob and thatch buildings (Figure 12).

Kevin McCabe's collection of cob buildings at Lower Tricombe Farm, near Honiton, East Devon, began in 1993. These comprise the

rebuilding of an existing cob building once used for agricultural purposes and now converted to a family home. This was awarded Best Converted Home 1995 by the Daily Telegraph newspaper. Other cob buildings at the site consist of a well house to cover and protect the water supply, a double garage and a workshop for himself and his wife. Kevin has mastered the skill of cob and his familiarity of the technique has allowed him to explore the formal opportunities presented by the material. Each building on the site demonstrates an advancing skill and a desire to push the material. For instance to support the principle roof truss of the garage he has used a massive cob column. Following the success of Lower Tricombe Farm, Kevin has since constructed another new house for his family, Keppell Gate, near Ottery St. Mary, East Devon, built between 2001 and 2002 (Figure 13). This continues to explore the curvilinear possibilities of cob with the house designed around an enormous cob chimney stack around which a cob staircase winds to access upper floors and roof space. In 2006 it was awarded the LABC (Local Authority Building Control) Best Vernacular House. An additional enterprise was the construction of a nearby house, the Cob House, Cadhay, built between 2006 and 2007 (Figure 14). This house was designed and built speculatively. Again this was award winning receiving the LABC Best Single New House in 2007 (42). Kevin's cob buildings have provided valuable training opportunities for enthusiasts keen to develop their own cob building skills. Sourcing soils from nearby all his sites, Kevin has developed an in depth knowledge of their appropriateness and has mixed soils where required to produce the optimum workable mix. Achieving substantial successful cob buildings provides the essential confidence for other potential cob home owners. Although Kevin is still one of a handful of Devon builders whose work focuses upon earth building, repairing and extending existing buildings and new build.

Architects Paul Bedford and Barry Jopson have designed two significant cob buildings. Completed in 2008, Lyon Cob House is a new private house next to the sloping banks of the River Dart at Dittisham, South Devon (Figure15). The walls are made of limewashed cob and local stone with underfloor heating from a ground source heat pump. In 2009 the project won two awards from LABC in the Sustainability Category for the South Devon region, and nationally the Best Vernacular Building Award (43). Again Kevin McCabe constructed the cob walls of this property (Figure 16).

A second dwelling designed by Bedford Jopson was the new house at Merton, a cob village in North West Devon. This was constructed by its owner Jeremy Sharpe, himself a traditional builder (44). This house uses the shuttered cob technique (Figure 17) to achieve a slightly different architectural language to that of those built by Kevin McCabe. This innovative technique has produced a dwelling which shares a familiar appearance and internal layout to recent dwellings constructed from more conventional materials such as rendered concrete block. Again building soil was sourced from the site and the pit produced by excavation conveniently forms a garden pond (Figure 18). Internally other innovations included a compacted and polished earth floor and a vaulted earth ceiling (Figure 19). Whilst this house respects the local vernacular style of cob and thatch, it is clearly seen as a new addition to the settlement.

Not part of the recent collection of Devon's new cob buildings, but nevertheless architecturally very important is Cobtun, Worcestershire, completed in 2004 (45). Although there is a Devon connection as the University of Plymouth advised the architects on the cob wall and Kevin McCabe was responsible for its construction. This single storey house was designed on a site near Worcester by John Christophers of Associated Architects of Birmingham. The site enjoys distant views of the River Severn and it is this that has informed the architectural form and orientation. An enormous cob wall contains and protects the house and gives it the name Cobtun, cob, one of its building materials and tun,

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19. House at Merton

20. Cobtun Protective cob wall. Photograph Martine Hamilton Knight

21. Cobtun South Elevation. Photograph Martine Hamilton Knight

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22. Cob Sculpture on Dartmoor. Photograph Mike Smallcombe

23. Cobtun Cob Wall detail. Photograph Martine Hamilton Knight

meaning an enclosure around a homestead. This wall begins near the site's entrance and separates the access route from the garden sweeping round to embrace and protect the house to the north (Figure 20). The contrasting lightweight fabric of the dwelling rests upon this substantial north wall opening out to the south and west to enjoy the beautiful garden and distant views of the river (Figure 21). Only two door openings in the cob wall provide access to the main entrance lobby and garage. What is striking about the design of this building is the combination of the ancient cob with the contemporary lightweight architecture of the rest of the building, each understood and appropriately used according to their function. The architect and client shared the same commitment to sustainability by using construction materials with low environmental impact. And it is this combination of sustainability and architecture that creates the real interest in this significant building (46). It is not surprising that this is another award winning project, gaining the prestigious RIBA (Royal Institute of British Architects) Best Environmental House in 2005.

7. THE FUTURE OF THE COB TECHNIQUE

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The survival of thousands of traditional cob buildings will mean the techniques will survive as it is important to keep these buildings in good order. Their occupants and conservationists value these buildings as providing pleasant accommodation and contribute significantly to regional and local identity. One just has to consider the financial investments in properties to realise it makes no sense to neglect these buildings. Their maintenance and repair requires knowledge of the technique so as not to put the buildings at risk through inappropriate interventions. Beginning to be critical is to continue to develop a better understanding of the thermal performance of cob walls. This is particularly important if we are considering whether cob buildings need upgrading thermally to decrease their carbon footprints. Attracting funding to continue the research already undertaken by University of Plymouth is difficult but necessary if we are to avoid putting these historic buildings at risk in our race to save energy.

The idea that the cob tradition could well provide appropriate regions of Europe including Devon with sustainable new buildings in the near future is unlikely to be realised. At the moment cob is a very marginal current construction technique in Devon and even less significant as a percentage of the new buildings constructed nationally. The generous legacy passed down to us by past generations has had very little influence on contemporary architecture. This is not surprising when one considers that traditionally the cob technique was known as the slow process (47). The time it takes to achieve a cob building certainly inhibits it potential use. Time is required to source and test appropriate raw materials, manufacture a mix, place it onto the wall and then allow it to dry. The total time required is unpredictable as the dry weather is impossible to predict in our maritime climate. The familiar adage 'time is money' is well known to the British construction industry. Fast track, reliable construction which is easy to programme is preferred to avoid the possibility of extending the length of the contract time. Farmers no longer undertake cob building interspersed with their other agricultural tasks. Farming like building construction has changed. Today the majority of contractors like to purchase their building materials already processed from builders' merchants not to dig for them and to manufacture on site. Skills too have to be available in the local work force. Whilst a handful of Devon builders possess this skill, it is likely that only increased interest and demand will encourage more to take up the skill of cob building.

Quality control is a major issue. Factory produced products come to site with reliable certified performance characteristics. Cob is an individual material whose performance has to be tested to satisfy the demands of our current construction industry. That performance is reliant upon the raw material and skills of the builder. The project managers/architects who today take responsibility for the building may well lack confidence when it comes to guaranteeing the performance through observation of the final cob wall without previous experience. In fact CEA at University of Plymouth

would recommend this, particularly where earth is proposed on a site where there is no tradition of its use surrounding the site. Occasionally advice has been given to not proceed with earth where suitable building materials are unavailable on site or nearby where sustainability is informing the design process. Not only is it environmentally unsound to source earth from distant locations in terms of transportation, it is also unlikely that earth building skills will be unavailable in the local labour force. Of course there are other reasons apart from sustainability as to why earth is selected for new buildings e.g. aesthetics, fashion or use of natural building product. Testing subsoil also determines the actual earth building technique which would naturally suit the material, unless modification of the raw material is acceptable. This is the reason why cob is recommended for the Devon soils as it suits their constituents. Blocks made from cob are an alternative as a building material and certainly have a place in cob repair. Pre-shrunk, they avoid the possibility of the repair material drying with wide gaps between the new and old materials. This is particularly successful if the existing cob material which has fallen out of the wall is reconstituted into the blocks and repair mortar.

The labour intensive aspect of cob also means there is no cost saving today, even though the raw material is free. Kevin McCabe's experience is that cob costs no less than any other walling material. When considering the overall cost of a building and the industry estimate that the walls cost approximately 10% of the total, the use of cob means only a significant saving if it is part of a self build project.

Procurement of new buildings in Britain is certainly against any major growth in the amount of new cob buildings. The majority of new British buildings are produced speculatively by developers. Their reason for so doing is financial profit making. So any material which is unconventional or labour intensive is rarely used unless it is in `one off` bespoke situations designed by architects for individual clients. The few recent cob buildings belong to this latter category apart from Kevin McCabe's house at Cadhay, which he designed and built speculatively to sell once completed.

The growing pressures to be more cautious in the use of resources; minimise pollution and carbon emission; and cherish tradition and regional and local identity, must ultimately re-instate cob buildings as a mainstream technique in Devon's construction industry. The new cob buildings which exist represent a variety of design opportunities. Kevin McCabe, Jill Smallcombe and Jacky Abey are maintaining the tradition but exploring the opportunities the use of this wet technique provides for architectural and sculptural form (Figure 22). The work of Paul Bedford, Barry Jopson and Jerry Sharpe show that cob can achieve a more conventional yet significant and high quality architecture. It is this approach which could be much more influential when large numbers of new buildings are proposed in the future. John Christopher of Associated Architects Cobtun is equally important showing how cob can easily have a place in contemporary design if its inherent characteristics are well understood and used appropriately in combination with other walling systems (Figure 23). The cob technique has come a long way in its recent history from the small bus shelters of Alfred Howard to the inspirational architecture of our recent award winning examples.

8. CONCLUSIONS

The use of cob, the vernacular earth building technique, which has fashioned so many of our well loved buildings in Devon and other areas of Europe will take 'no leap of faith' to be used in the future. The survival and continued occupation of this cob legacy shows the technique to turn subsoil into a reliable building material works. Knowledge of cob is beginning to exist in the current construction industry although there is an amnesia as to the value of this technique by the majority.

"Vernacular architecture is conservative by nature. It is the product of the tried and true, and is the result of the work of generations of experienced builders who by trial and error have come to agree upon what works and what is acceptable. They have studied the nature and behaviour of the available materials empirically and transmitted this knowledge to subsequent generations"(48). We must accept our ancestors' gift and make it our own.

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