The natural insulation materials construction essay

This is usually the type of building that are considered alternative today, have their heredity in structures that humans have been constructing for centuries. The reason why these building techniques are gaining popularity in modern times is twofold. First, the old building techniques are far more eco-friendly than the majority structures we used to seeing; second, these structures are simple enough in nature that they can built cheaply and can be built without the aid of a lot of the heavy and expensive equipment which is normally related with most new construction.

Currently words such as green, sustainable and alternative get used often in the construction industry, which make its pretty confusing and difficult to tell if any one particular method or material fall under one or many of these heading. The report will help identify, green alternative building method and materials which are less damaging to the environment than a similar practice used in conventional lumber-framed construction. The need to find alternative practices will encompass any building technique that can be done repeatedly without changing the environment in any noticeable way.

The Importance of Finding alternative Materials

As the world population continues to grow at an alarming rate, people are realizing that planet cannot sustain such continuous and exponential growth. With land being increasable limited and we are continually diminishing our natural resource such are timber, with majority of it being used to build homes. It is evident that we cannot continue to use our natural material at this rate to build our homes. With the awareness of these natural materials become increasing limited, has made the construction industry rethink their way and start to think more about sustainable construction. Using alternative

material for 8building homes is much more environmental sustainable than conventional homes building. Depending on the type and amount of sustainable materials used, these types of alternative material can reduce the carbon footprint which is produce in building homes.

According to the Worldwatch Institute, an independent organization that analyzes critical global issues, one-fourth of the world’s wood and one-sixth of its fresh water are used in building construction. This situation will only become worse as the world’s population and more people continue to migrate toward cities. The greater demands also will add pressure on increasingly scarce essential resources, especially water.

The Environment

The environment has now become issues and with it being heightened news, the Governments and individuals have seem to take notice and now taking to make a change because we cannot continuing abusing the environment, this is not an option anymore.

The chart below shows the proportion of CO2 emissions in the UK from buildings in use, the construction process (mainly due to the CO2 from the manufacture of building materials) and from all other sectors including industry, transport, agriculture etc. Buildings in use contribute about half of our CO2 emissions (and consume about half of our energy use).

Figure 1 – CO2 emissions

The next chart shows where these emissions come from and with over half of our energy use and CO2 emissions from building use come from heating our buildings.

Figure two – Energy Waste.

Government Action

The UK government have stated that England must take action now, in order to make vast improvement to energy efficiency in both new and existing buildings. The government have set many ambitious goals, an example of one: they anticipate dramatic energy reductions to achieve its goal that all new homes in England will be carbon-neutral by 2016. World Business Council for Sustainable Development (2007)

There are three main approaches to energy neutrality:

Cut buildings' energy demand by, for example, using equipment that is more energy efficient

Produce energy locally from renewable and otherwise wasted energy resources

Share energy – create buildings that can generate surplus energy and feed it into an intelligent grid infrastructure.

Efficiency gains in buildings are likely to provide the greatest energy reductions and in many cases will be the most economic option. A study by McKinsey estimated that demand reduction measures with no net cost could almost halve expected growth in global electricity demand. The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report estimates that by 2020 CO2 emissions from building energy used can be reduced by 29% at no net cost World Business Council for Sustainable

Development (2007) and a cost curve for greenhouse gas reduction, McKinsey Quarterly 2007 Number 1.

Fox and Murrell (1989) state the fundamental ecology principle of renewable material, such as wood is sustainable source and are renewable however, for materials like metal, plastic, gravel and sand, stone-based materials such as cement, concrete and plaster, have been used cannot be used again, their consumption if the earth itself. (Berge, 1992) The extraction of certain raw material can be very destructive effects especially to the water table and wildlife habitats. Over usage of these materials can affect the availabilities of in the near future, cause environmental degradation, and contribute to global warming.

Impact of the Construction

The industry has a major impact on the environment, it affect are not only on the resources it consumes but also the waste it produces. The construction industry is accountable for producing a whole variety of different wastes, the amount and type of which depends on factors such as the stage of construction, type of construction work and practices on site. In Great Britain, over 90% of non-energy minerals is extracted and are used to supply the construction industry with materials. Furthermore, every year more than 70 million tonnes of construction and demolition waste has been produced in England and Wales

The key is alternative basic materials because they have historically driven innovation in every industry, and could spur significant advances in today’s housing. In order to gain acceptance, however, basic alternative materials

must offer more benefits than the traditional materials or methods they replace. They must reduce costs, increase design flexibility, enhance sustainability, perform multiple functions, have superior performance characteristics, or meet a market niche. Another potential driver for adopting alternative basic materials is a shortage of existing natural materials or concerns about their long-term sustainability. Martín(2005) states that in recent years, there has been a shortages of core natural resources; including lumber, steel, and gypsum, and this has driven construction costs higher. This volatility of supply and price motivates the industry to look for more sustainable solutions. Sustainability and resource shortages, in fact, will help to drive innovations in the future.

The objective of alternative basic materials is to develop new materials that spur innovation by serving multiple functions, increasing cost-effectiveness and efficiency, and using more sustainable materials. In many cases, these technologies form building systems that enable other Concept Home principles such as integrated functions, floor plan flexibility, and improved production processes.

Alternative basic materials consist of core technologies that manufacturers can use to create products or systems and composite systems that builders can purchase and use to build homes. Martín(2005)

Before considering the use of alternative materials, and before implementing into homes,

practical issues must be considered, (Berge, 1992) say to be realistic to imagine a technology that functions in line holistic ideas, none-mainstream

approach but also providing humanity with an acceptable material standard of living, basically Berge is trying to say there just be a balance between the Eco approach and what consumer want.

Government Schemes and Regulation

After The Stern Review (2006) which advised that the implications of climate change couldn’t be avoided any longer and urgent action was required, the government took notice and started implementing changes to building regulations. In 2007, the Government introduced the Code for Sustainable Homes to help improve the energy efficiency and sustainability of houses, by setting target for all new houses to achieve a carbon rate of zero by 2016. This is a level 6 in the Code for Sustainable.

Currently, the standards of the code are not mandatory for private house builders but there are intentions to incorporate them into the Building Regulations over the next couple years, starting with changes to Part L in 2010.

CAN I ADD MORE

Constructing environmental friendly house

To construct an environmental friendly houses are to focus on reducing the environmental impact of both its construction and its ongoing operation. This is achievable at the design phase by selecting the correct material and the process.

Environmental friendly houses and sustainable construction offer an exciting future for building houses. With the prospect of living in an environmentally

efficient house that can generate its own power. Also reducing waste and running costs, safe in the knowledge that your house is not effecting but instead helping the environment. This is a positive step for a sustainable future.

It is well documented the impacts that human activity has had on our planet and with the Office for Climate Change 2010, attributing 27% of the UK's total carbon emissions to household heating and electricity, house construction is an area where we can make a huge difference.

Ecological impact

During the development and construction stages of house being built, a ecological assessment should be carried out that reduces its impact. Also the see if it is feasible to create new habitats in the form of green or living roofs.

Materials

Houses are constructed using a vast range of products and materials from a range of sources. For each one the industry must need to consider:

The sustainability of the raw materials used.

The lifespan of the material.

Its performance characteristics as part of the building fabric.

The energy use and waste generated from:

The acquisition of raw materials.

Processing.

Transportation.

Manufacture.

The possibility for re-use or recyclability at the end of life.

the-self-build-guide. co. uk(2009)

Luckily, a lot of the legwork has been done for you on this one, with resources such as the BRE’s Green Guide, which provides environmental ratings for building materials and components.

Material specific organisations like the Forest Stewardship Council (FSC) only certify timber taken from responsibly managed sources.

You can find suppliers who use environmental management systems (EMS) to maximise the environmental efficiency of their businesses. EMS accreditation can be awarded through British Standards (BS) and the International Organisation for Standardisation (ISO).

Alternative building systems improve on standard brick construction through their use of high performance materials and accurate construction techniques. Although many alternative systems involve the construction of buildings in-situ, in the same way that brick buildings are built, there are also many that are turning to off-site construction techniques to improve accuracy.

Another benefit of off-site construction

Alternative Natural Construction: Building Systems

Alternative building systems improve on standard brick construction through their use of high performance materials and accurate construction techniques. Although many alternative systems involve the construction of buildings in-situ, in the same way that brick buildings are built, there are also many that are turning to off-site construction techniques to improve accuracy.

Another benefit of off-site construction is that it can drastically reduce waste – by up to 90% over traditional building methods.

Mud brick

Mud brick is a building material, which consists of clay-loam soil puddle with water, sometimes containing straw. The ideal soil requires clay content and the straw can be added to reduce drying and cracking. However, almost any soil can be adapted to make mud bricks; making it one of the most flexible and convenient building methods. It is most popular due to its simplicity, which is easily grasped by the layperson with limited experience, time or resources. If the design and construction are good, the building will last indefinitely.

http://static. panoramio. com/photos/original/11435929. jpg

Mud brick has several advantages over conventional fired clay or concrete masonry. The advantages include:

Low in embodied energy

Utilisation of natural resources and minimal use of manufactured products

Good sound absorption characteristics

High thermal mass

A claimed ability to “ breath”

Suited to a wide range of soils

Easily manufactured and worked

Flexibility in design/colour/surface finishes

Insulation properties similar to those of concrete or brickwork

The disadvantages

Mud brick building is very labour intensive

Texts and magazines suggest it is possible to make 100 bricks per day per person, although that level of productivity comes with experience and fitness! Thousands of bricks are required for most dwellings.

Only two or three courses of bricks can be laid at one time, because the courses need to dry out before more are added on top, to prevent the wall slumping or warping.

The technique requires a lot of water, which can be a problem in dry areas.

Although it is possible to make bricks in wet weather, a large undercover area is needed.

Mud brick building is very labour intensive and quite tiring (the most exhausting part is mixing the soil and water).

(BBC – h2g2, 2003)

Timber

Wood is a very low carbon and sustainable material, it is important that the wood is ethically sourced and treated. There are types of wooden construction systems, they are:

timber framing – which is constructed completely on-site

Structural Insulated Panels (SIP)- they are manufactured off-site and assemble on-site.

Timber framing is a cost effective method of construction which is available , they can be used for buildings up to around seven stories high and can be highly insulated: level 4 or 5 of the Code for Sustainable Homes should be achievable.

The drawbacks of timber farming are that construction time to build the walls to the specification at the suppliers. With the possibilities of dry rot or wood worm if the timber is not treated properly in the first place. Which mean that only certified companies can be used.

SIPs, this method usages large sheets of plywood or chipboard (more or less) to sandwich to provide a stern insulting core, with these structurally sound panels then joined together to construct the building. SIPs are more expensive, are slightly less flexible in the buildings they produce, but are

generally extremely well insulated and airtight: level 6 of the Code for Sustainable Homes is achievable.

The drawback of wood-clad panels is that they do not provide any thermal mass as part of their composition. Frechette (2009) http://www. greenhomebuilding. com/sip. htm, stats that when SIP it will burn, it has been demonstrated that they remain structurally sound for a lengthy period during a fire and do not emit fumes any more hazardous than those of wood products. Another possible concern is with insects or rodents nesting in the insulation since this can be an ideal habitat for them. One last concern is that a well-constructed SIP structure is practically hermetically sealed, which means that the walls are not breathable; for this reason they require some sort of mechanical ventilation system for healthful habitation.

Straw bale Construction

http://hurricanecandice. files. wordpress. com/2009/04/straw-bale-home-1. jpg

Brian Waite from straw bale house design states that the UK alone produces 4 million tons of surplus straw every year – enough for 250, 000 homes. Straw must have the lowest embodied energy of any building material and is probably the cheapest and most sustainable. Straw-bales have an insulation “ U” value much better than required by the building regulations as well as excellent sound deadening properties which, together, give a living space an ambience that has to be experienced to be appreciated.

Contrary to common perception straw-bales in a building, is not a fire risk, is not a vermin risk and are not short-term, but would compost back into the earth if and when required to do so. Straw in bales is so tightly bound that it doesn’t contain enough air to support combustion, just add a (carbon neutral) “ breathing” lime render/plaster and any fire regulation requirement is easily met. There is no nutritional value in straw and so it does not attract vermin, it is only voids that vermin like, so proper attention to detail is the only precaution needed. Lime rendered straw-bales “ breath” so evening out fluctuations of humidity thereby creating a healthier environment.

Straw bale construction is the use of compressed blocks (bales) of straw, either as fill for a wall cavity (non-load bearing) or as a structural component of a wall (load bearing.) In each case, the interior and exterior sides of the bale wall are covered (by stucco, plaster, clay, or another treatment.)

The drawback of straw is that it requires special measures must be taken to provide nailing surfaces, since straw bales do not hold nails as well as wood and anchored to the foundations. The external weatherproof cladding will need to be good, as bales will rot badly if they get damp If straw bales are not available within a few hundred miles of your construction site, the cost of shipping them, along with the potential pollution from the transportation, must be taken into account.

Views of the industry Straw bales may be plastered inside and out to provide thermal mass and, like standard construction, the walls must be protected from moisture

Straw bale can be more resistant to termites and vermin than stick construction, but (as with any type of construction), elimination of cracks and holes is key

Rammed Earth

http://cdn. webecoist. com/wp-content/uploads/2009/01/rammed-earth-home. jpg

Rammed earth walls (aka pies) are constructed by the compacting (ramming) of moistened subsoil into place between temporary formwork panels. When dried, the result is a dense, hard monolithic wall.

Rammed earth is an ancient form of construction, usually associated with arid areas. There remain plentiful examples of the form around the world – evidence that rammed earth is a successful and durable way of building. A few historical rammed earth buildings are to be found in the UK.

Rammed earth construction is once again gaining in popularity for home builders looking for eco-friendly options. With rammed earth, you’re using the dirt under your feet (or from a local quarry) to build a house. This is certainly a “ green” practice since it usually makes use of local materials (local dirt!) and you don’t need lumber, quarried stone, brick, etc. to be transported from long distances.

Rammed earth construction has its pros and cons of course. Let’s take a look at the positives and negatives.

A properly sited and designed rammed earth home is ideal for passive solar strategies, so it can be great for an off-the-grid house. The thick, dense

walls absorb the warmth from the sun all day and slowly release the heat into the interior of the house at night. This helps keep heating bills low in the winter, and these homes tend to stay cool in the summer as well.

Dirt is an easy-to-acquire material and while there are some requirements (not all dirt is going to have the right mix of sand and clay), you ought to be able to get it locally, so this tends to be an eco-friendly building material.

Soil selection needs to be done carefully, and if you are able to use dirt from the building site, you'll end up with some big holes you need to figure out how to work into the landscape. Though it might seem that a house made out of dirt would be cheap, rammed earth construction actually tends to cost 5 to 15% more than conventional construction (due to the labour-intensive process of creating the rammed earth forms).

It's difficult to impossible to create rounded or sculpturally shaped walls the way you can with other materials. Homes made with rammed earth construction are going to be boxy in nature.

Constructing a rammed earth house in the UK would probably require extra insulation, (it's typical to add foam insulation to exterior walls and then cover it up with stucco) as rammed earth method is not suitable for colder climates

Cob

http://www. ranchomastatal. com/images/PicsTim100405009. jpg

Another mud-hut style of building, but there are occupied cob houses around the UK that are anything up to 500 years old. Not bad for a mud hut.

Cob houses are built from a mixture of earth, clay, sand and straw. The ingredients are mixed together with a little water until they form a paste-like substance. The paste is then slapped onto a stone foundation to form walls that are often around two foot thick, then more and more slapped on to form a monolithic structural building. The slap is usually built up in layers about 18 inches high to avoid slumping.

The great thing about cob houses is that they can be built into more or less any shape you care to dream up: curves, vaults, domes etc. This can result in some pretty funky buildings. The drawback is that it is very labour intensive and the walls can take up to a year to fully set.

Cob is a Cheap, sustainable and eco-friendly method of construction using local materials. This is as load-bearing method of construction and needs no framework. A cob house uses 60 per cent less timber than a stud frame building. a cob house typically uses 20 per cent less energy.

Cob house are naturally energy-efficient to cool and heat, provided the builder takes care to insulate the ceiling, and attend to solar positioning advantages. Straw bales embedded into north walls make this truer. Heat tends to pass out through north facing walls. Straw bales tend to keep this heat in, better that only earth, which is more porous for air passage.

Contractor do not like working with Cob material as it is time consuming and labour-intensive. It makes the need for community obvious, while demonstrating our inherent unified power. Cob has to “ breathe” – to dry out naturally after becoming wet. It used to be that the exterior walls were either left bare or lime rendered (which is expensive these days). Excessive

moisture can give you a probleme, as the material needs some moisture (3-5% is considered good – much higher than that and you might have rising damp). Cob generally exceeds the minimum u-values for a house.

Cost & benefits compared below

Building system

Cost (£/m2)*

Benefits

Drawbacks

Traditional brick & block

800-1500

Well known, flexible, popular, robust, durable.

Materials not eco-friendly, high waste, often poor performance.

Timber framing

200-1000

Sustainable, cheap, fairly rapid, well known, good performance.

Poor image, needs good planning.

SIP

300-1300

Sustainable, excellent performance, rapid, can be fairly cheap.

Poorly understood, few contractors, inflexible, needs good planning.

Straw bale

80-1000

Very sustainable, good performance, can be very cheap.

Misunderstood and could have low sale value, limited lifespan, needs very good planning.

Rammed earth

500-1500***

Very sustainable, durable, good performance.

Misunderstood and could have low sale value, needs insulating, easily water damaged, long build time.

Cob

500-1500***

Very sustainable, durable, good performance, very flexible.

Misunderstood, needs insulating, easily water damaged, long build time.

Traditional Material

Traditional Building Method and Materials used

The majority of new homes in England and Wales are built using traditional masonry construction. With most people in the construction industry are

familiar with this method. This method has many advantages, such as a deep historical and psychological attachment to masonry construction, which has contributes to its persistence use as the main house building method in the UK. A national survey by MORI found that 61% of respondents would prefer to buy a newly built property of traditional block construction.

Most building systems in England and Wales use a timber frame for the skeleton of the house , this is the core of most traditional method of construction, however manufacturing developments have moved many of these methods into the categorization of modern methods of construction discussed below. This is currently second most popular technique for new home construction in the UK and, according to the UK Timber Frame Association, is the fastest growing method of construction in the UK. Traditionally used in North America and Scandinavia, as those areas are rich in timber resources, it comes with some good environmental credentials.

http://www. ajbuilding. co. uk/userimages/parsonagefarm3. jpg

Before considering what type of alternative method or material to use, we need to understand how current building methods and materials are being used. Below is a basic method

Once the excavation and installation of the foundations is completed, the bricklayers erect cavity walls that consist of an inner and outer skin.

The inner skin is the main structural element, which supports internal floors and the roof structure. It is constructed using concrete blocks laid on beds of sand and cement mortar.

The outer skin of the house is the first line of defence against the elements and provides the aesthetic element to the structure. This is constructed usually with brick, stone or block work, this can produces a number of finishes. The two skins are connected by steel wall ties and separated by a cavity that is partially or fully filled with insulation.

Internal floors, they are constructed using timber joists, composite timber beams, or one of many precast concrete systems which are available. The roof is usually traditional cut timber or prefabricated truss construction.

Traditional Material

Concrete

With environment and health issues, concrete are non-toxic stains and sealants can be used. They are Manufacturer of Portland cement contributes between 5-8% of carbon dioxide emissions and greenhouse gases, which means concrete is non-green material. It under goes a chemical process of limestone, it creates the same amount of carbon dioxide in weight, but concrete can be grounded and recycled for use in roads and pavements (Holistic Interior Designs, 2007)

Concrete is often used in the construction and constructing home and is there a need to find an alternative material to replace concrete. Traditional concrete contains material such as stone or other material with similar properties. Concrete is made from gravel, sand, cement and water through a chemical process, the concrete is next, poured into slabs for worktops and panels – creating a stone like appearance. The traditional use for concrete are use walls, floors, fireplace surrounds, worktops, panels, wall finishes,

concrete furniture, sinks and basins. It offers an exceptionally high lifespan – up to 3 times that of alternate building materials

The use of concrete has many advantages, Farrell (2009) summaries the advantages and disadvantages of concrete: which are stated below

Advantages:

Fire, moisture, insect, rot and rust resistant,

Can be poured into form Absorbs and retains heat very well,

Concrete is water resistant and will not warp, rust or rot.

Concrete homes are less affected by flooding or by leaks from tanks or water pipes. Concrete walls between adjoining properties offer high levels of security and peace of mind to property owners.

Disadvantages:

Which are Poor insulation properties

Concrete May Not Offer Pleasant Aesthetic

Embodied Energy of concrete manufacture creates very high levels of carbon emission.

Origin Extraction of the raw materials in very large quantities has a negative impact on the local surrounding environments.

Transportation of raw materials over long distances accounts for further release of carbon dioxide levels into the atmosphere

Bricks

There are now more environmentally friendly alternatives to traditional concrete on the market, made with hemp or carbon neutral concrete. Traditional concrete should be the last choice. Which will be explain later chapter.

Are Bricks Green or Not?

(Proefrock, 2007) asks what is brick made of, which is just clay and water and that is it, there are no complex chemicals, no exotic compounds, no imported components. Brick are effectively just a manufactured clay stone with a special shape. It breaks down into earth since it comes from earth. (Proefrock, 2007) Clay mining is comparatively benign, compared to ore mining for metals, which requires far more material to be extracted and processed to produce the finished product. Clay is not a resource that is in short supply, which makes it a more attractive material to use, as well. The main reason brick is not an even greener building material is that it takes a lot of energy to make a brick. However, the extra energy is relative. (Proefrock, 2007)

Finding alternative Insulation

sustainablebuild. co. uk (2010) state: insulation is a key component of sustainable building design. A well insulated home reduces energy bills by keeping warm in the winter and cools in the summer, and this in turn cuts down carbon emissions linked to global climate change.

In regard to energy efficiency, investing in high levels of insulation materials when constructing houses is a cost-effective method of saving energy, rather than investing in expensive heating technologies. It is important to choose the correct type materials in the context of whole building design.

Insulation materials are used in roofs, walls and floors. Alternative methods that have solid walls structures from cob and adobe cannot be insulated, Cob and Adobe already offers good thermal mass to compensate. Houses that construction with Timber frame require wall insulation in the form of batts (pre-cut sections that are designed to fit between stud walls), rolls or boards. Other types of construction methods such as brick or concrete insulate with spray foam, loose fill or rolls.

Insulation materials work by resisting heat flow, measured by an R-value (the higher the R-value, the greater the insulation). This R-value varies according to material type, density and thickness, and is affected by thermal bridging, unwanted heat flo