

Combining Natural Building Materials for Energy Efficiency

by Catherine Wanek

It's a natural inclination for Permaculturists to use available, on-site materials in building our homes. Doing so conserves energy and resources - our own and planetary. But understanding the specific qualities of our on-site resources and how they can be combined allows us to create the most efficient and elegant homes. This is important because we want to design and build homes which require the least energy input while returning the greatest comfort.

Beginning always with the selection of a building site, two of the most effective strategies for energy-efficiency are solar orientation and earth-coupling. By simply designing window placement to capture the winter sun, a major part of our heating needs can be accomplished with minimal effort. If the site happens to be on a hillside, coupling the home with the constant year-round temperature of the earth below the frost line (about 55-65 degrees) will keep indoor

temperatures within a few degrees of the human comfort zone. Combining earth-coupling and passive solar design enhances the effectiveness of both - which is the basic concept that structures like the Michael Reynolds Earthships are built upon. This, however, requires fine-tuning to local climactic conditions, for one must be careful of overheating in certain seasons and one must also make sure there is adequate day-long sun in the winter months.

Relatively few sites are sun-facing hillsides, so in what ways should we compensate for such circumstances? Common to nearly every building is earth. To build a sturdy foundation, it's generally necessary to excavate, and after the topsoil is stockpiled for garden use, the sub-soil must be dealt with properly. Very often it can be combined with other natural materials, such as sand, sticks, and straw, to form load-bearing or non-structural wall systems, including

adobe, cob, straw-clay, rammed earth, and wattle-and-daub. Other materials often found on-site and that can be used in construction are stones and timber, both of which may need to be cleared from garden areas or building sites

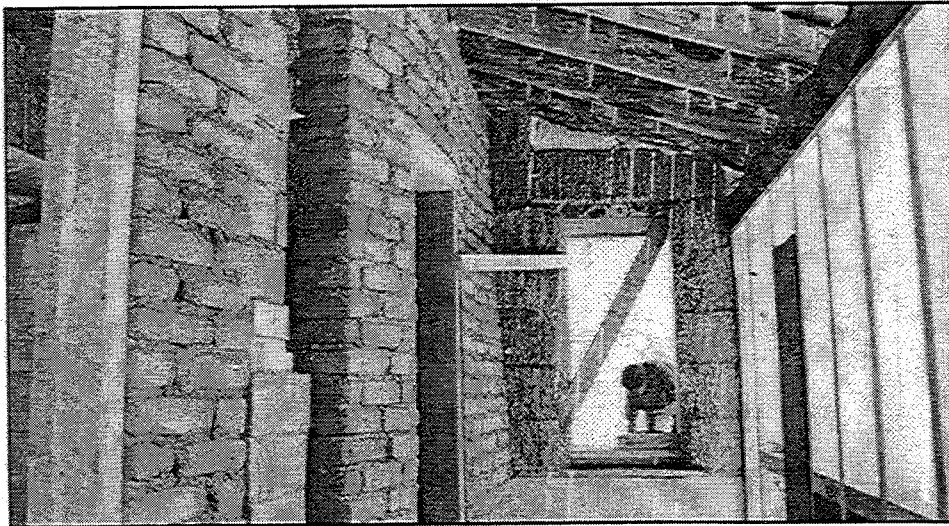
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anyway. But to utilize natural building materials most effectively, it's essential to understand their properties.

Timber in dryland bioregions is generally a precious resource, given watersheds' propensity to soil erosion if trees are removed, but it still can be harvested sustainably. Timber has great structural strength, rigidity, and beauty, but it lacks insulation value, which is important in the colder climates. Thus, a log home in such climates is not the most appropriate use of this resource. However, selectively harvesting logs for a roof system could be a good use of on-site timber.

Types of trees not generally chosen for building can also be great assets. The regionally ubiquitous juniper tree, for example, grows slowly and in organic shapes, hence it's not well-suited to roof structures. However, this scorned tree is a member of the cedar family, so it is extremely rot-resistant and strong. It makes good structural posts, sills and trim wood, and left in its organic shapes can be amazingly beautiful. Willow, maple, and other saplings that often need to be thinned can also be used for pinning straw-bale wall systems or in wattle and daub walls (instead of buying and using rebar).

Stone and earth are also strong and can be utilized as structural materials. Their density makes them good thermal mass, which



This adobe wall serves as a thermal mass wall, and will receive winter sun from the south-facing windows. It is wrapped with straw bales for insulation, and a masonry stove will heat the walls. This structure sits at 8000', and was built during Build Here Now, the permaculture and natural building convergence, held in June, 1999.

Photo by Catherine Wanek



The exterior straw bale wall of this Build Here Now structure is held together with bamboo (rather than rebar) on both sides of the wall, which are tied together through the bales. This wall is being prepared for mud plastering.

Photo by Catherine Wanek

means that they absorb heat or cold from the air temperature around them. But thermal mass materials absorb heat most effectively when the sun strikes it directly. As the air temperature changes, a thermal mass will slowly equalize to match it, releasing the heat or cold stored within the material. used well, this can help to both warm and cool our

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homes, but misunderstood it can be an energy drain or cause discomfort. The desert cities of Arizona, for instance, soak up the summer sun during the day, which means they often stay hot all night long from the heat stored in their concrete structures, sidewalks, and streets.

Not often found on site, but cheap and available in nearly every region of the United States, is straw, the stalk of many cereal grains. Since humans first began to build shelters, straw or grass has been used in combination with earth in bricks, walls, and floors. When the bailing machine was invented, it became possible to multiply straw's efficacy by turning it into large building blocks. In bale form

straw can be used structurally, and it provides something few natural materials can - excellent insulation. It is the dead air space contained within the hollowed stalk of straw that makes it such a good insulator, so it is most efficient if bale walls are sealed with a plaster to prevent air convection.

Good insulation in walls and ceilings protects indoor environments from daily andseasonal temperature swings, providing the greatest comfort for the least energy input, which is why I favor straw bales for exterior wall systems in most situations. But bales take up a lot of floor space, so they are less suited as interior partitions, where insulation isn't needed anyway. For inside walls, athermal mass material is most useful, where it serves

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to moderate temperature. Earth and straw combinations such as cob, adobe, or straw-clay offer good thermal mass, and add infinite possibilities for creating interior spaces and sculpting built-in furniture. For example, earthen seats, shelves, fireplaces, and tables can make the perfect natural addition to a home.

More reasons to use earthen materials inside the home are their abilities to absorb sound, odors, and moisture. Water vapor from bathing and cooking can build up and provide an environment for mold and fungal growth, but earthen walls and plaster have an enormous capacity to moderate humidity. Also, straw bales finished with plaster, or in combination with straw-clay walls, are virtually fire-proof. Used to create floors, earth provides thermal mass for direct solar gain and a surface to walk on that is easy on the body.

While the cost of using on-site natural materials is often "dirt-cheap", techniques vary in how much work they take in order to use. Even using machinery, such materials as cob, straw-clay, adobe and rammed earth walls are very labor intensive. But building with bales can go very quickly, as it's basically the stacking of giant building blocks without mortar - although people can make it more complicated. So using bales for exterior walls and clay-straw techniques for interior walls is consistent with conserving both fossil fuels and human energy resources in our buildings.

By simply orienting our homes to the sun and using an insulating thermal mass, comfortable shelter can be created primarily from natural materials. Understanding their properties and how they can complement each other will lead to the most energy-efficient combinations without limiting creativity. The natural home, then, is an extension of a permacultural landscape, functioning as a healthy sustainable environment that nurtures human life while using primarily regenerative resources.

Catherine Wanek is Managing Editor of The Last Straw, the grassroots journal of straw-bale and natural building. Producer/Director of the Building With Straw series of videos, her most recent video is titled Urban Permaculture. She and her husband Pete Fust operate the Black Range Lodge in Kingston, New Mexico, which they are developing as a demonstration center for sustainable living. Catherine was a key organizer of the Build Here Now convergence. She can be reached via e-mail at <blackrange@zianet.com>.