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Sustainable Building

Why Build Sustainably?

- **Building resources are not endlessly renewable.** Nationally, 245,000 residential units are taken down each year. 72% of the nation's lumber is used by homebuilders.
- **Water and fossil fuels are both depletable resources.** Using these resources for carrying waste, for transporting building materials and for constructing buildings is unnecessary because local building materials can be used and waste can be composted.
- **Building materials should not jeopardize the health of its users.** Both the actual materials and the emissions from conventional materials such as carpet adhesives and paints can be harmful. There are documented cases of "sick building syndrome", a condition in which inhabitants experience respiratory and dermatological problems caused by allergic reactions to building materials.
- **A building's relationship to its surroundings affects the building's users.** There are many ways in which to build at a site while retaining and respecting the feel of the environment. By taking into account agricultural, geographical, topographical and climatic environmental features, a building can interact well with its surroundings and create a pleasant atmosphere for the building's users.

What are Sustainable Buildings?

- **Recycled Materials**: Reuses materials such as framing lumber, bricks, hardwood flooring, stair units and treads, windows, bathtubs, toilets, sinks, doors, shelving and cabinets. Also recycled polystyrene can be fashioned into building material blocks.
- **Nonpolluting Materials**: Uses stains, finishes, paints, carpets and carpet adhesives produced with non-toxic methods and materials.
- **Renewable Materials**: Uses materials such as straw or earth to build structures. These materials are often locally available as well, reducing pollution and costs from transportation.
- **Energy and Water Efficiency**: Conserves resources by using other methods of producing electricity and dealing with waste.
- **Sensitive Design**: Creates buildings that are sensitive to surrounding factors such as earthquakes, extreme cold or hot weather, outstanding plants or topography, cultural context and other such elements.

Sources:

- Malin, Nadav. "Carpeting, Indoor Air Quality, and the Environment." *Environmental Building News*. 3:6.
- Malin, Nadav. 'Structure as Finish: The Pros and Cons of Leaving off Layers." *Environmental Building News*. 9:3.
- "Newsbriefs." *Environmental Building News*. 9:3.
- Wilson, Alex and Yost, Peter. "Building and the Environment: The Numbers." *Environmental Building News*. 10:5.

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Building with Recycled Materials

Why Build with Recycled Materials?

- **Recycled materials are energy efficient.** Recycled polystyrene and wood block building products have energy efficiency ratings above that of conventional insulation and building materials. This is due to their insulation properties and to the large thermal mass of the solid walls. These walls also prevent drafts because the poured cement used with them in construction eliminates air pockets.
- **Recycled building products save materials from the landfill.** Plastics that would otherwise go into a landfill can be recycled and turned into building blocks, reducing the need to harvest lumber from forests. Recycled wood building projects save wood from being wasted and decrease the need to harvest forests.
- **Recycled material mixed with cement or concrete is fire resistant.** Many recycled wood or polystyrene building materials are more fire resistant that conventionally built houses.

What are Recycled Materials?

- **Polystyrene Building Forms**
  - **Concrete Forms**: Uses polystyrene recycled material and steel to create a permanent form into which concrete walls are poured. These forms are stacked in a manner similar to interlocking building blocks and have excellent insulation and sound absorption properties, as well as being sturdy and wear-resistant. Examples include Arxx™ or Polysteel™.
  - **Cement Forms**: Mixes cement with recycled polystyrene to create a building system around which concrete is poured, creating a wall. The structures are highly energy efficient, fire resistant and sound absorbing. Examples include Cempo™.
- **Wood Cement Building Forms**: Mineralizes and bonds recycled wood chips with cement, under pressure, to create a building form which interlocks and serves as a mold into which concrete can also be poured. The resulting structure is a wall with excellent sound absorption and fire resistant properties that is non-toxic and can be recycled. Examples include Durisol™.

Sources:
- "Arxx", November 27, 2000, http://www.arxxbuild.com.html, (6 August, 2001).
- "Cempo Forms, Inc.", 2001, http://www.cempo.com.html, (10 July, 2001).
- "Durisol", October 25, 2001, http://www.durisol.com.html, (10 July, 2001).
- "Pulysteel", 2001, http://www.polysteel.com.html, (10 July, 2001).

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Alternative Building Systems

Why Build with Alternative Building Systems?

- **Alternative building systems use renewable or sustainable resources.** As opposed to wood, steel, masonry or concrete, straw and earth are both renewable resources. Straw is a waste product from the harvest of a variety of grains and is usually burned. Earth can often be used directly from the work site.

- **Alternative building systems are energy efficient.** Straw, earth and polystyrene all have insulating qualities superior to conventional insulating materials. Straw insulates at three times and polystyrene at twice the rate of conventional buildings. Earth buildings are cool in the summer and warm in the winter thanks to their insulating abilities.

What are Alternative Building Systems?

- **Straw Bale**: Uses the straw bales as the main structural support or the in-fill. Bales are stacked like building blocks, often on a poured concrete wall foundation, with wooden frames for windows and doors. Steel, wood or bamboo pins can join the bales and reinforce the walls, or the bales can sit in a wood, steel or masonry/concrete structural system. Straw bale buildings are energy efficient, affordable and ecological.

- **Earth**: Uses earth in the form of baked bricks, cut sod, wattle-and-daub or cob (mud mixed with chopped straw), rammed earth or pisé (earth compacted into wooden forms) or tiles as the main building material. Earth is affordable, simple, a durable and an adaptable material, abundant locally, plastic yet strong, rot and termite proof, cool in summer and warm in winter.

- **Polystyrene Cement Building Forms**: Uses a mixture of recycled polystyrene waste products and cement to make wall panels. Steel reinforcement bars are installed into the panels during the wall raising. Concrete is then poured into the panels to form a monolithic "honeycombed" wall. Panels are finished with exterior plaster or wood paneling and have superb sound insulation and energy efficiency qualities.

Sources:
- Pearson, David. *The Natural House Book.* Simon & Schuster, New York: 1989.
- King, Bruce. *Buildings of Earth and Straw.* Ecological Design Press, California: 1996.

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Building with Straw

Why Build with Straw?

- **Building with straw saves energy.** Plastered straw bale buildings insulate three times over typical dry-wall buildings. The energy savings accrue for the building's life span.
- **Straw buildings are fire resistant.** Densely packed into bales, panels or even thatch, it is remarkably fire resistant. Plastered straw bale structures are considerably more fire resistant than conventional buildings. If the roof and exposed wood elements are made fireproof, a straw bale building can survive firestorms that would consume other structures.
- **Straw buildings are personal.** Similar to a barn raising, a group of people can build the walls and have the satisfaction of living in a structure they helped build themselves.
- **Straw buildings use inexpensive and renewable materials**. 140 million tons of straw are produced as waste annually in North America. It is usually burned, creating carbon monoxide. Wood has a longer cycle and is more expensive. Using straw could decrease logging in old-growth forests and scenic recreational areas.
- **Building with straw reduces pollution and health hazards**. Substitution of straw for the raw materials of most wall insulation saves processing energy and reduces oil-based fuel use. Straw is produced in many locales, reducing fossil fuel use in transport. Using straw instead of fiberglass insulation eliminates health hazards for workers involved in the manufacture and placement of the fiberglass.

What are Straw Buildings?

- **Straw Bale**
  - **Load Bearing**: Uses straw bales as the main structural support and usually has a simple design. Bales are stacked on a poured concrete wall foundation, with wooden frames for windows and doors. Steel, wood or bamboo pins join the bales and reinforce the walls.
  - **Non-Load Bearing**: Uses a wood, steel or masonry/concrete structural system to carry the roof load. Straw bales are insulating fill within the structure. This style permits a greater variety of roof designs, complex floor plans and multi-story buildings.
- **Straw Panels**: Uses manufactured panels of compressed straw as a structural form, which can bear the weight of the building.
- **Straw Thatch**: Creates roofing material by weaving straw or other fibrous material in layers**.**
- **Straw Insulation**: Uses loose or bundled straw to fill cavities in walls or roofing.

Source:

- Wilson, Alex. "Straw: The Next Great Building Material?" *Environmental Building News*. 4:3.
- King, Bruce. *Buildings of Earth and Straw.* Ecological Design Press, California: 1996.

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Building with Earth

Why Build with Earth?

- **Earth buildings are energy efficient.** Earth buildings have superb insulating qualities, absorbing heat during the day and letting if off through cool nights. In the summer, earth insulates against heat. Building with earth often doesn't involve the use of power tools.
- **Earth buildings use resources that are readily available, renewable and affordable.** Many of the materials for earth buildings can often be found directly on the building site, decreasing the need for fossil fuel-burning transportation.
- **Building with earth is easy.** Many methods of earth building can be done by a group of people, who then have the satisfaction of living in a structure they built themselves.
- **Earth buildings are internationally popular.** Because earth is such a ubiquitous and adaptable material, people worldwide use earth to build a variety of structures in many different ways.

What are Earth Buildings?

- **Cob or Wattle-and-Daub**: Creates walls with a mixture of mud and sticks or straw as reinforcement over a framework which then dries solid. This method is one of the most commonly used internationally.
- **Rammed Earth**: Uses a mixture of soil, sand, water and usually cement or another stabilizing ingredient. It is compacted into a wall-formed mold, which is later removed allowing the walls to dry.
- **Gunearth or Pisé**: Sprays a mixture of soil, sand, water and usually cement or another stabilizing ingredient onto a metal or wooden formed frame or into a mold, which then dries in that shape.
- **Adobe**: Uses clay, sand and straw as a mixture to form unfired bricks. This mixture can also be poured into a form, similar to rammed earth building. The walls can then be covered with a lime wash.

Sources:
- Pearson, David. *The Natural House Book*. Simon & Schuster, New York: 1989.
- King, Bruce. *Buildings of Earth and Straw*. Ecological Design Press, California: 1996.

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Alternative Waste Water Systems

Why Build with Alternative Water Systems?

- **Drinking water is a precious resource not to be used to carry waste.** As opposed to conventional toilets, which use almost 20 liters of water to flush, water-conserving toilets can use only 5 liters. The flushing of toilets (creating blackwater) constitutes 38 to 45% of all interior water use in the US and is the single largest use of water indoors. Composting toilets do not need water to function at all.
- **Graywater, water from bathing and washing, can be reused.** The nitrogen, phosphorous and potassium from soap and body waste are actually organic matter that can be harmful pollutants when discarded into the environment. When responsibly recycled, however, they can be beneficial nutrients. It is estimated that 42 to 79% of household graywater comes from the bathtub and shower, 5 to 23% from laundry facilities, 10 to 17% from the kitchen sink or dishwasher, and 5 to 6% from the bathroom sink.
- **Alternative wastewater systems reduce the need for septic system pumping.** A septic system that receives only graywater and does not contain waste from garbage disposals or toilets, only needs to be pumped once every twenty years as opposed to the conventional once every three years.

What are Alternative Wastewater Systems?

- **Graywater Systems**:
  - **Direct Reuse:** Reuses graywater for flushing toilets and for lawn and garden irrigation.
  - **Cleaning Reuse:** Filters water through deep soil beds, or shallow gravel beds, in a space where plants can be grown. Graywater can also be circulated through evapotranspiration trenches (where plants absorb the water and release it as water vapor, letting the solids filter out to be composted) or through constructed wetlands where the water is drained into a fabricated pool where grasses and rushes grow and filter the water.
- **Composting Toilets**: Composts wastes through microbial processes, heating the waste to a temperature so as to kill any harmful bacteria, and producing materials that in some areas can be used as fertilizer. This system does not use water, eliminating the production of blackwater (water from toilets), and the contamination of precious drinking water.
- **Eliminating Garbage Disposals**: Reduces waste added to septic systems, prolonging the life of the septic system. According to the US EPA, household garbage disposals contribute 850% more organic matter and 777% more suspended solids to wastewater than do toilets.

Sources:

- Talbot, John. *Simply Build Green*. Findhorn Press, Scotland: 1997.
- Jenkins, Joseph. *The Humanure Handbook*. Jenkins Publishing, Pennsylvania: 1999.

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Alternative Energy Systems

Why Build with Alternative Energy Systems?

- **Energy consumption in the US is currently rising.** General energy consumption in the US, measured in quads, has steadily risen from 84 quads in 1992 to 93 quads in 1999.
- **As demands for energy increases, the cost of energy also increases.** Higher gas prices nationally and the recent energy crisis in California both demonstrate the economic results of increased energy consumption.
- **Higher energy consumption is proportional to increasing pollution**. The US has consistently been one of the highest contributors to carbon dioxide emissions.
- **Alternative energy systems consume less energy or produce energy in a cleaner manner.**

What are Alternative Energy Systems?

- **Solar Power**
  - **Active**: Collects the sun's energy with panels and convert it to heat, useable for water heating, space heating, cooling, and electricity generation (also called Solar Thermal or Photovoltaic).
  - **Passive**: Orients buildings to make optimal use of heating and daylighting from the sun, letting the building serve as the solar collector and heat storage/distribution system.
- **Wind Power**: Powers an electricity generator with turbines that spin with the wind.
- **Fuel Cell**: Combines hydrogen and oxygen to make water and free electrodes, which can be stored as electric current in battery-like cells.
- **Biomass Power**: Produces methane from human and agricultural wastes and uses it to generate electricity with heat, in a manner similar to active solar power.
- **Ground Source Heat Pumps**: Modifies building temperatures with hot or cool air stored in the earth or in walls and circulated through vents.
- **Thermal Mass**: Regulates building temperatures by using rocks or water to store hot or cool air which can be circulated throughout the building.
- **Cooling Tower**: Draws hot air up into a tower and cool air into the building from outside, creating air circulation.

Sources:
- *Environmental Building News*. 1992 – 1999.
- Sosna Energy Consulting. *Energy Compliance News*. November 2000.