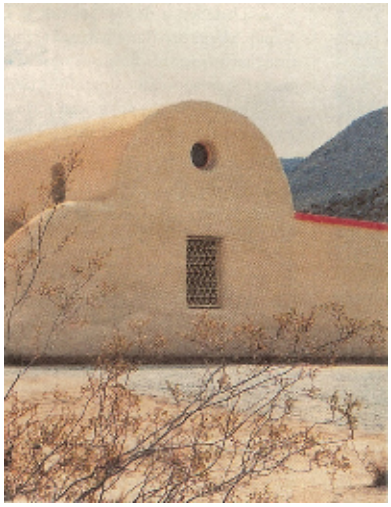
A Symphony in Straw

By M.E.A. McNeil

(Photographs by Eva Soltes)

An improbable crew labors on the Mojave Desert, stacking straw bales like giant Legos. A young musician mixes cobb -- water with dirt and straw, slopping it into a wheelbarrow; an art historian totes it to a museum director who slathers it onto a course of bales with her hands.



The house they are building, a retreat for composer Lou Harrison, is the first of its kind: Built of only straw bales, wire, and stucco, with an otherwise unsupported vaulted ceiling, it is engineered to take advantage of the seismic properties of bales. Its location, at Joshua Tree, California, is near six earthquake faults.

Harrison, 83, is tying off odd size bales. "You have something that can feed you and house you. It grows up out of the ground; it's right there!" he says, "It makes sense."

The aesthetics of thick walls with deep-set windows and curved corners appeal to Harrison, who is influenced by the vernacular design of the Egyptian architect Hassan Fathy. Harrison calls it "my straw cave".

Although bales in most contemporary straw bale houses serve as insulation in a wood frame, the Harrison house is frameless -- called "Nebraska style," after the first straw bale houses, built by American homesteaders in the barren Sandhills. Houses of baled prairie grass, plastered with marsh mud, proved comfortable in extreme heat and cold; many have been continuously occupied for nearly a century. Lucille Cross, who grew up in a bale house, says that it was so quiet inside that a tornado passed while her parents were engrossed in a game of cards. Acoustically, says Harrison, "It's heaven for a musician."

Many left the Sandhills during the Depression and did not take their cheap, functional, but déclassé building method with them. Fifty years later, the ecological building movement values the straw bale as an energy efficient renewable resource.

Straw bale building has grown rapidly over the last decade. The last year in which new buildings could be counted was 1995, when there were 1000. The number is estimated to have

From top down: stretching wire over the plywood vaulting; the building takes shape; Lou Harrison with friends and helpers.

doubled yearly since then, and structures range from high-end homes to schools and fire stations. California now has 50 builders specializing in straw bale construction. An internet list-serve has provided rapid dissemination of information worldwide with a daily peer review of evolving design.

Straw is the waste left after the harvest of grain. It is often confused with hay, which attracts rodents to its nutrients; the corrections column of *The Last Straw* quarterly is titled "I Smell Errata".

Straw is composed of hollow cellulose tubes which insulate like down by trapping and holding air. According to a report for the Department of Energy, "straw bale construction …could provide up to a 60 percent reduction in building heating loads over current practice." Builder John Swearingen, explains that bales act as thermal mass: "The temperature swings are so gradual that physiologically your body adjusts; it can fall to 63 degrees before you feel uncomfortable."

Unlike loose straw, which is highly flammable, straw bales are so tightly packed that they are about three times more fire retardant than standard construction. Swearingen likes to take a blowtorch to a bale to convince doubters. But water is the nemesis of straw, which needs the protection of stucco and an impermeable footing to prevent rot.

At about $3.00 each, straw bales are cheap, particularly when evaluated for embodied energy – the actual environmental cost to get a material into a building. "There is a Luddite strain; we are conscious of trying to keep it non-proprietary and low tech," says Swearingen.

"A core of very practical people, like farmers, have built more straw bale than anyone else." Although an increasing number of straw bale buildings are architect designed, most walls are put up with sweat equity – a bale raising like Harrison's with family and friends.

While the ecological value of straw inspired the straw bale building movement, most builders first cite economic reasons for choosing bales for building. That suits Harrison, who describes himself as "a 1929 man, marked by the Depression."

Plans for his house were drawn by Harrison with architect Janet Johnston and Swearingen. The composer outlined the proportions of his floor plan according to musical ratios – 3:1 for the long main room. "It's hardly a new idea," he explains, referring to Renaissance writings. Echoing the 3:1 theme, three small rooms line one side of the great room, and the other side opens onto three patios between flying buttresses. At the end of the great room is a window covered in mushrabeyeh work – Middle Eastern inspired wood lattice to create shade, designed and built by art historian Chris Dubais.

From top down: scaffolding over interior stucco; straw bales against desert sky; the structure is nearly ready for exterior cement.

In 1995, Harrison began to think about building a desert retreat away from the rheumy winter air of his ocean home at Aptos, California. That year, a young engineer, David Mar, was in Kobe, Japan, examining the quake shattered remains of stiff, strong buildings – the rubble of old school seismic design. The experience confirmed Mar's understanding that "buildings need to be able to deform and absorb a lot of movement to survive." Straw bales, he thought, could have advantages in seismic engineering – bulk,

lightness, and energy absorption. He played with models until he came up "the extreme of … something really silly with bales." -- a straw bale vault.

He showed up with his model at a meeting of CASBA, California Straw Bale Association. Mar's plan had an uncanny similarity to the Harrison house design; "John (Swearingen) would call it karma," Mar said. But it was far from certain that Mar could figure out a way to make the Harrison house vault out of straw bales. "I thought you could theoretically."

Most building codes that even address straw bale construction restrict the use of bales to infill for a frame, functionally reducing the straw to insulation. This is, according to Mar, at odds with the seismic qualities of straw bale walls. "Bales are giant shock absorbers. It's totally cool. People don't give you new material to play with every day."

In May, 1998, the crew from Swearingen's company Skillful Means, constructed a full-scale prototype section of the straw bale vault in a vacant lot in Berkeley, California. To witness the destruction of the test arch, Swearingen, Mar and Johnston gathered with CASBA architects and engineers -- along with a few neighborhood children. The arch bounced back from successive loads from a hydraulic test jack. "Each bale forms an energy absorbing strut as it is compressed by the encapsulating wire mesh when the vault distorts," explains Mar. The jack pushed to its capacity at loads of more than three times code requirements. The children went home disappointed; "We were never able to collapse the vault," said Mar. "This is the best time to be a structural engineer doing seismic design. There is so much room to innovate. In ten years all the fun stuff will be done."

Whatever the test proved, The San Bernardino County Land Use Services, Building and Safety Division denied the application to build: "The straw bale is not an approved material to form the arch structure…"

Mar explained, "Most work is done with the conventional building code, which is very straightforward. Then there is this other branch called Alternative Procedures. Almost nobody goes down that other branch. They can't go back to first principles – the first principles of engineering."

When the building department stopped answering phone calls about the project, architect Janet Johnston, left the job site trailer for a yurt in Mongolia; she spent the summer of 1999 subsisting on mutton and sour milk, supervising the building of a straw bale kindergarten

for the UNDP (United Nations Development Program) and ADRA (Adventist Development and Relief Agency). In an area where clinics and schools have to close in the winter for lack of heating fuel, straw bale structures cut heating costs by 70 percent.

Subsequently, seismic engineering developed for the Harrison house was adapted for use by UNDP and ANDRA in Eastern China. Straw bale insulation in 68 houses there will save about 6,600 tons of carbon dioxide emissions from the burning of coal for fuel. Funding for the project came from the sale of carbon credits on a new world market

Despite the Bush administration's decision not to pursue a carbon credit program, the market in credits has not turned down, according to Dr. Mark Trexler, of Trexler Associates in Portland, Oregon, who brokered the sale. "It's not a question of if, it's a question of when" the market will take off. His clients include those motivated by concerns for the environment, public relations, speculation, or positioning for what some see as the inevitable day when emissions controls are in place.

The 7.21 magnitude earthquake on October 16, 1999, near Joshua Tree, could not have improved chances for approval of the house of straw, wire, and stucco. (Tours are still conducted of the scarps from the 1992 Landers quake.) Mar was undeterred: "It sounds kind of morbid, but we (seismic engineers) live for earthquakes, 'cause that's the testing ground. If I had to worry about people being safe, this is as good as it gets."

Yet another review of the project, by forensic engineer Sig Freeman, concluded that the test vault would withstand "the demands of even the most severe earthquake," which "exceeded our expectations." Still, the project languished.

Life went on: David Mar and his group received the equivalent of an Oscar -- the 1999 Best Structure Award from The National Council of Structural Engineering Associations -- for the "exceptionally bold and well executed" seismic redesign of the old Pacific Union Building in San Francisco. The San Francisco Symphony played an evening of works by Harrison under the rubric "American Maverick." Johnston, while "frying my brains out" on the desert waiting for the permit, fell in love with an English rock climber. Swearingen, a lay Buddhist teacher, officiated at Mar's wedding, and soon after, at Johnston's. And the life partner of Lou Harrison, the instrument maker Bill Colvig, died.

When approval to build came, two years after the initial application, footings for the building were buried in desert sand, Skillful Means had seven other straw bale houses in various stages of construction, and Harrison wondered if he had the heart to build.

The house had become “one of the most over-engineered little houses in America,” according to Mar. “When I am discouraged, I put on Lou’s music, and I remember why I am doing this.”

At the house site, the eponymous Joshua trees hold a rare show of ivory blossoms in their shaggy arms. Friends have rallied from hundreds of miles to heft 80 pound bales for the fun of it. Harrison mans the hose, measuring water by the splash for the cobb mix. He asks playfully if anyone knows sign language for straw bale, answering by stroking his upturned palm under his white beard for straw, then miming a box with his hands. Heir to the house, choreographer and children’s writer Remy Charlip, dances along the walls, writing orders for shortened bales on a paper plate. Gamelan music beats from a boom box like a heart.

For Lou Harrison, it could not have been an ordinary house. “I’m not sure,” laughs Mar, “if Lou knows how innovative he is.”