

Extreme Rammed Earth

Rammed-earth walls used to be elementary. When the ancient building method was revived in the U.S. almost 40 years ago, mineral soils were typically scooped



Trial walls were rammed on site and tested for compressive strength.



Ingredients were combined in a volumetric mixer and conveyed to the forms by a belt truck.



Mineral soils were trucked from several quarries to achieve the desired color coordination. Embedded steel columns support the adjoining floors and roofs.

from the job site, moistened, and compacted one thin layer at a time inside simple forms resting on concrete footings. Portland cement was sometimes mixed in to add strength and durability, and concrete columns and bond beams often supported the roof. In the raw, the economical walls seemed to beg for a sod roof.

These days, though, you're more likely to find rammed earth serving as functional art in upscale architecture, with a hefty price tag to match. A striking example is the Walnut Farm Retreat, a sprawling net-zero contemporary taking shape about a mile from the San Andreas Fault near Hollister, Calif. Designed by architect Jonathan Feldman, the home has a curved spine of colorfully stratified, 2-foot-thick rammed-earth parapet walls that soar up to 22 feet high. The walls, which were formed by project GC Stocker & Allaire and rammed by Benchmark Development, required 400 cubic yards of rejected fines gathered from rock quarries in California and Nevada. Inside are two grids of #5 rebar, plus steel columns that support the abutting floors and roofs. The county required the walls to reach a compressive strength of 1,500 psi, or almost twice the strength specified by the structural engineer. Samples were mocked up on site and

repeatedly tested until it was determined that adding about three and a half sacks of white or block cement per compacted cubic yard of soil would get the job done without washing out the colors.

The massive, ram-proof formwork contained I-joists, glulams, and other components that would later reappear in the house and its 100-foot entry bridge. Benchmark used a 10-yard volumetric mixer to blend the walls' ingredients, a belt truck to convey the relatively dry mix to the forms, and pneumatic tampers to compress the mix one 8-inch lift at a time from inside the forms. The ramming phase alone took 12 guys about five weeks to complete. The walls are capped with concrete and sealed with a water repellent.

Altogether, the earthwork cost about the same as natural-stone veneered walls, Feldman says. — *Bruce Greenlaw*