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The California Academy of Sciences' beautiful new living-roof may well spark a revolution

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The hills rise like giant bubbles surfacing from an extraterrestrial pond: natural, yet somehow alien. Although they are dotted with native plants, the effect is anything but mundane. Instead they incite images of a revolutionary future — a place designed by intelligent creatures who have transcended the divisions between nature and culture. Welcome to the most natural part of San Francisco's new Academy of Sciences, its living roof.

Like zoos, nature museums have never really done it for me. Sure, I love to gape at the circling shark or the twisting rainforest vine as much as the next city bumpkin, but the clash between my appreciation for nature and this most unnatural of settings always undermines the experience. Too often, the dull rectangular rooms outfitted with square tanks, and filled with carefully staged fake nature, serve only to emphasize how little we've learned from our astounding planet. But Renzo Piano's architectural wonder breaks the square mold.

The museum is scheduled to open next fall, although it's architecturally mostly complete now. A tour of the ultra-environmental museum one moonlit evening last week reminded me that natural landscapes and the design imagination need not live apart.

The building itself — with its spherical planetarium and domed rainforest, high-tech piazza with suspended glass roof, and plexiglass tunnels winding through marine ecosystems — is innovative enough to banish the stuffy taint associated with natural history. It's also arguably the greenest museum in the world, built to achieve a platinum rating from Leadership in Energy and Environmental Design's Green Building Rating System. But the undulating green roof, planted with four native ground covers and five local wildflowers, will be a destination in itself. And in some ways, these hills of 1.7 million plants growing in 50,000 biodegradable coconut husk trays comprise the most inspiring element of the whole museum.

The roof design has multiple functions. Implemented by architectural landscapers SWA Group, in collaboration with

green roof guru Paul Kephart of Rana Creek Living Architecture in Carmel Valley, the garden is structured around a network of rock in mesh cages, which allow drainage and offer support to the coconut husk trays. The steep inclines of the little hills draw cool air into the central courtyard. Heat-sensing skylights automatically open like clam shells to ventilate and provide natural sunlight to the coral reefs and rainforest within.



California Academy of Sciences' new green roof and piazza. California Academy of Sciences photo by Stephanie Stone.

But the seven hillocks, which are said to echo the seven major hills of San Francisco, do more than simply express the curves and support the spaces of the interior, they give the museum a living experiment in native plant restoration amidst the alien greenery of Golden Gate Park.

Piano has suggested that the idea was to pick up a piece of the park and slide the museum under it, but it's much more than that. Since the plants were chosen to attract local butterflies, birds, and insects, some of which are endangered, the roof offers a quietly utopian statement.

Even as we grow and change it seems to whisper, "We can do better."

Perhaps even more crucial than its role as native landscaping, it introduces the turf roof to San Franciscans as an architectural choice. Living roofs have been around for centuries in Europe and some American pioneers incorporated them into early dwellings. And if you've ever gone for a walk across the greenery of Yerba Buena Gardens or Civic Center Plaza, you have experienced the joys of a green roof. But the Civic Center Plaza roof, like most of the city's large scale turf roofs, is used to hide a subterranean parking lot. That's great. But that's not exactly the same as choosing and designing a green roof for the tops of buildings.



California Academy of Sciences' planetarium dome as seen from its new green roof. California Academy of Sciences photo by Stephanie Stone.

I grew up under a turf roof in a home my father designed, and so the idea of grass growing over your head has never seemed new to me. But the early turf technology (like early solar panels) didn't always deliver on the dream. My mother's strategically placed buckets around the dining room and family room offered a humble testimony to that fact. Huddled under our dripping grassy roof, we sometimes felt the way bunnies must feel in their burrows, waiting for the rain to stop.

In the past decade however, green roofs have come of age. Although Gap Inc., brought large scale green roofs to the Bay Area in 1997 with its 69,000 square-foot green headquarters in San Bruno, the concept hasn't taken off here as quickly as in many other places. In Germany, it's already mainstream, with 7 percent of all new construction incorporating a green roof into the design. In England, large and small scale living roofs have spawned a movement of enthusiastic practitioners, researchers and designers, buoyed by government incentives. In Chicago, Mayor Richard Daley's love for green roofs led to the new roof energy code, which requires white (reflective) or green (vegetated) roofs, and has produced some 120 new green roofs in the city center (including its city hall).

Heck, even the Mormons have green roofs! Salt Lake City's Church of Jesus Christ of Latter-day Saints Conference Center features an eight-acre multi-level roof resembling mountain meadows, planted with 300 types of wildflowers.

In an era of carbon consciousness, it's only natural that green roofs should gain currency for a wide variety of reasons. By providing insulation, they lower energy bills. By absorbing rain water, they reduce storm runoff — one of the primary ways nitrate and phosphorous pollution get into our ground water is via roof runoff. (The Academy of Sciences is designed to reduce runoff by 70 percent.)

Populated by plants, they clean the air, absorb urban noise and relax us with their natural beauty. In hot climates, they greatly reduce the heat island effect, in which cities amplify the heat of the sun and create hotter climates. Some research has shown that in hot cities like Riyadh, Saudi Arabia, green roofs could reduce inner city temperatures by 10 degrees.

So what's stopping the literal greening of San Francisco's skyline? One deterrent is price — though turf roofs are supposed to last twice as long as traditional roofs, they are more expensive — an estimated 300 percent more. But factoring in the building's lower energy costs and reduced storm runoff infrastructure lowers the price substantially. And as turf roofs grow more popular, the price has dropped substantially.

Not every structure is built to carry the extra load of a soil roof (which gets substantially heavier when wet), but light-weight soils and plants have made the turf roof surprisingly adaptable to older homes. Toyota's non-automotive division has come up with a "turf mat" of two-inch-thick lawn tiles that might work for roofs that can't carry a traditional turf roof.

According to Mark Palmer of San Francisco's Department of the Environment, the green roof is gaining in popularity. "We're seeing more and more residential applications for turf roofs in the building department," he said, adding that the Department of Building Inspection is currently working on a set of criteria for living roofs. Since projects that cross a certain environmental threshold now can get into the priority permit pool, both homeowners and developers are eager to design with green building in mind. A green roof is one way to get green brownie points.

If you're interested in building with a green roof or retrofitting an existing roof, where should you start? It's best to begin with a structural engineer who can calculate your home's strength. The next step might be to research kinds of turf systems that have been used on your sort of roof.

I can't imagine that the Academy won't inspire a local living-roof mania. And not a minute too soon. According to Palmer, the next 25 years of building have the potential to create a whole new world. "Eighty percent of our buildings will be new or renovated by 2035," he says. "So it's a tremendous opportunity to change our environment."