# SAFER PASSAGE

## FIVE DESIGN TEAMS COMPETED TO HELP ANIMALS CROSS A ROAD.

BY LINDA MCINTYRE


1 EXCLUSIONARY FENCING

2 BICYCLE PATH

3 STORMWATER INFRASTRUCTURE CONNECTIONS

4 FOREST, SHRUB, AND MEADOW PLANTING

5 HYPAR VAULT STRUCTURE BELOW

6 JACK-TUNNEL WILDLIFE UNDERPASS

7 WET MEADOW AND WATER CATCHMENT

8 AGS RAIL

9 EXPANDED VEHICULAR TRAFFIC LANES

10 BREAKDOWN LANE AND SNOW SHOULDER

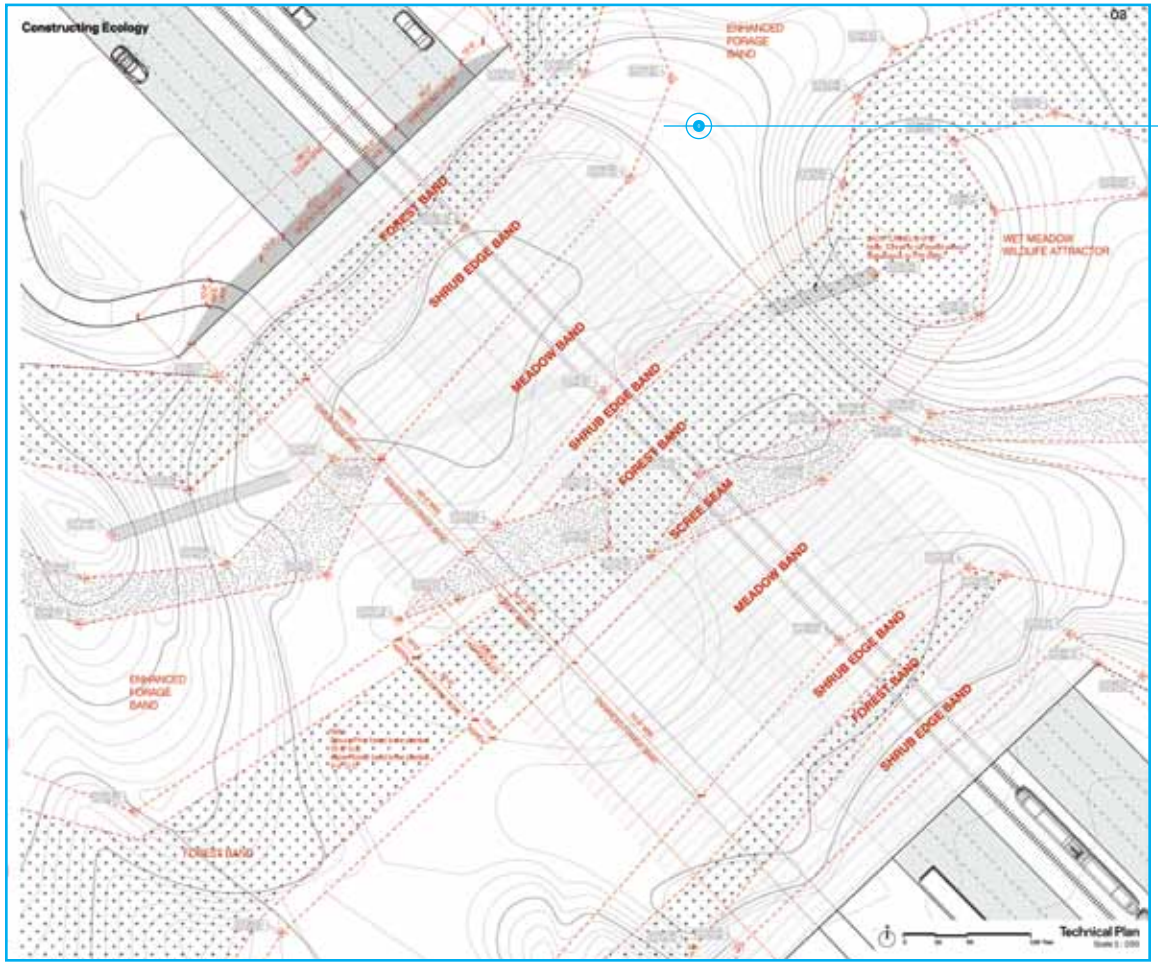
**ABOVE**
The winning design, by HNTB + MVVA, would extend the habitat corridors and landscape bands at West Vail Pass, Colorado.

**IMAGE CREDIT**
Courtesy ARC Competition

Where roads crisscross habitat, danger lurks for both animals and drivers. Deer account for most car–animal collisions—the Insurance Information Institute estimates there are more than 1.6 million of these crashes every year, resulting in about 200 human deaths, tens of thousands of injuries, and more than $4.6 billion in medical and auto repair costs. But millions of other animals—moose, bear, and elk as well as smaller mammals, amphibians, and invertebrates—are also killed by drivers each year, taking a big toll on species populations.

Planned crossings that funnel creature traffic over or under roads can make everyone safer, says Tony Clevenger, a wildlife ecologist with the Western Transportation Institute (WTI) at Montana State University. He has studied the use and impact of crossings in Canada's Banff National Park, where a series of 22 underpasses and two overpasses has reduced wildlife fatalities among species including wolves, grizzly bears, elk, lynx, mountain lions, and moose by 80 percent.

But Clevenger says the structures are considered luxury items rather than much-needed tools to help remedy habitat fragmentation because they're so expensive. The cost of overpasses, which are usually made of traditional road-building materials such as cast-in-place concrete and steel, has tripled over the past 12 years, and there has been little innovation in design or materials aimed at cost reductions. In addition, says the ecologist and planner Nina-Marie Lister, the surface of many of these crossings is simply a "green toupee" of soil and plants slapped on top of the crossing with little thought given to habitat quality, let alone design.




**RIGHT**
The planting and landscape plan for the HNTB + MVVA design would encourage wildlife movement with understory planting, selective thinning of the tree canopy, and controlled burns.

**IMAGE CREDIT**
Courtesy ARC Competition

The compelling data compiled by Clevenger and other researchers inspired a group led by the WTI and the New York City-based Woodcock Foundation to sponsor the first ARC International Wildlife Crossing Infrastructure Design Competition in 2009. The competition brief sought designs for a site on Interstate 70 in West Vail Pass, Colorado. Landscape architecture firms were integral members of the five teams whose designs made it to the final round. The winning design, created by engineering firm HNTB and Michael Van Valkenburgh Associates (MVVA) with Applied Ecological Services, was announced in late January, at the annual meeting of the National Academies' Transportation Research Board after presentations by each finalist team.

Lister, who served as a consultant to the competition, says organizers hope the competition will raise the profile of wildlife crossings. They're increasingly common in western North America but still relatively rare in other areas. The organizers also wanted to amp up the crossings' effectiveness—and their design quotient. "We know they work to reduce collisions and both animal and human mortality," she says. "Now we want to show what the possibilities are, with more interdisciplinary design that can attract more species and new materials that can improve habitat."

The competition brief emphasized feasibility and adaptability as well as ecological sensitivity. Cost effectiveness was also an important consideration for the jury, chaired by Charles Waldheim, Affiliate ASLA, who heads the landscape architecture program at Harvard's Graduate School of Design. The winning HNTB + MVVA design is based on precast concrete modules that can be combined in wide or narrow applications and adapted to a wide range of roadside terrain and foundation types, lowering future design costs. Another team, led by Balmori Associates, proposed glue-laminated beams made from local pines killed by the devastating outbreak of pine beetle. A novel approach was also suggested by the team led by Janet Rosenberg + Associates, which called for inexpensive wood-core fiberglass in a striking red hue. The colorful supports would invite human attention (education was part of the program) but read as unflashy gray to most other mammals.

Each finalist received a $15,000 honorarium, and the winning team picked up an additional $40,000. No funding has been allocated to build a crossing at the competition site yet, but all finalist teams are considered prequalified for any requests for proposals that the Colorado Department of Transportation (CDOT) might issue to build a crossing there.

The timing for the competition was ideal, says Monique DiGregorio of the Western Environmental Law Center, the Colorado liaison for the competition. Planning is currently under way for a stretch of Interstate 70 between Denver and Glenwood Springs. CDOT's environmental assessment of the area is due this spring, and funding will be based on this document. DiGregorio is enthusiastic about the winning design. "As someone who works often with engineers at CDOT, I think they will find this an approachable way to work with this challenging location," she says. ●

HNTB + **MVVA** (NEW YORK) WITH APPLIED ECOLOGICAL SERVICES

# HYPAR-NATURE

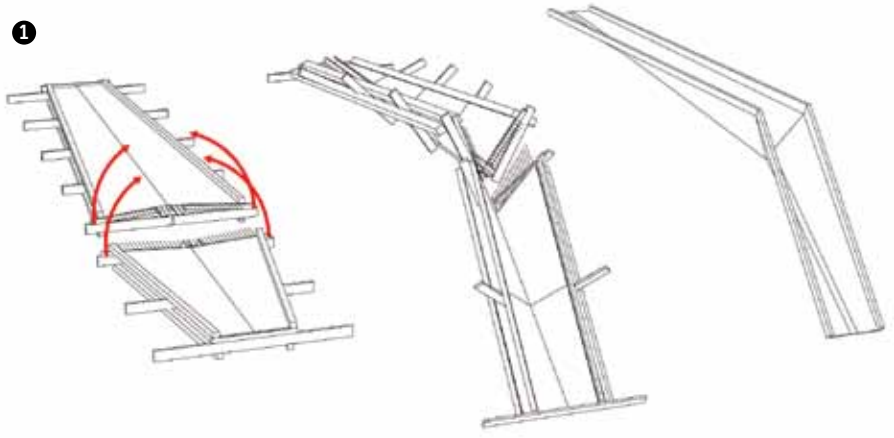
The crux of the winning design is a precast thin-shell concrete module in a hyperbolic paraboloid or "hypar" vault shape. Two of the modules could be joined at the center to create a three-hinged arch across a roadway, and the modules can also be configured to create retaining walls, sound barriers, bike path shelters, and fencing supports. The vaults are designed to lock together, and the concave shape of each piece would promote efficient drainage of the entire built structure.

Ted Zoli, the technical director for bridges at HNTB, says the design could easily be built from commercially available forms, and that precast concrete facilities are accessible around the United States—no location is more than 250 miles from a facility. "We tried to evolve existing technology, not invent something new," he says. The jury cited this elegant use of everyday materials in its announcement.

Robert Rock, a senior associate at MVVA, says the landscape architecture challenge for minimal disturbance on a mountainous site was slightly counterintuitive. "Usually we try to balance cut and fill on a site," he says. "But here the best solution was an additive process—the only real cut at the site would involve using a backhoe and cutting a trench for footings."

The team hopes a prototype of its scalable design can be built soon. "It doesn't have to be the size of a football field, or cost $8.3 million," says Rock. "It can be a half, a third, a quarter of that size. But if we don't start building, we won't get to the next steps for innovation, education, and research." ●

❶



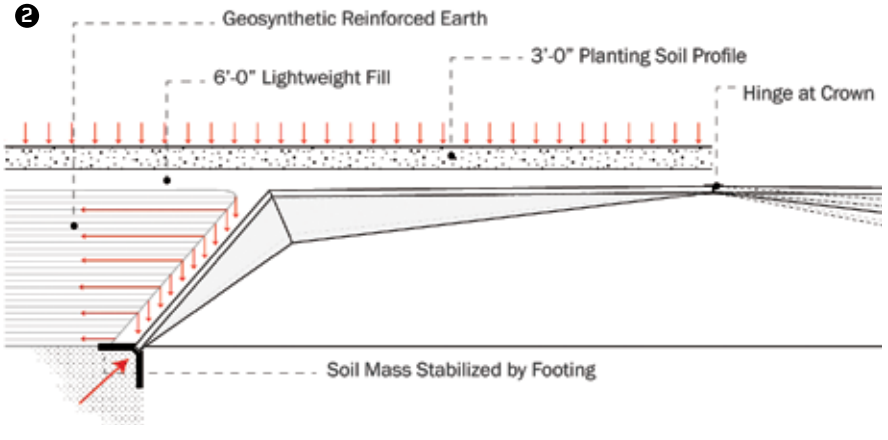
**1 DRAINAGE**
The cast concrete module would promote drainage and could be used for a variety of structural purposes.

**2 GRADE CHANGE**
Most of the grade change would be fill, minimizing site disturbance.

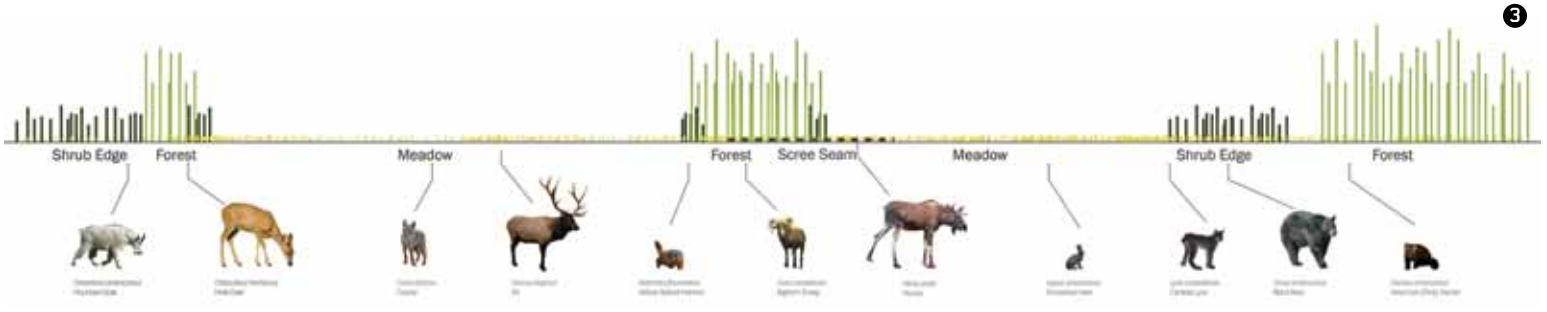
**3 VARIED PLANTING**
Varied planting provides both shelter and open views to the other side.

**IMAGE CREDITS**
Courtesy ARC Competition

❷




❸

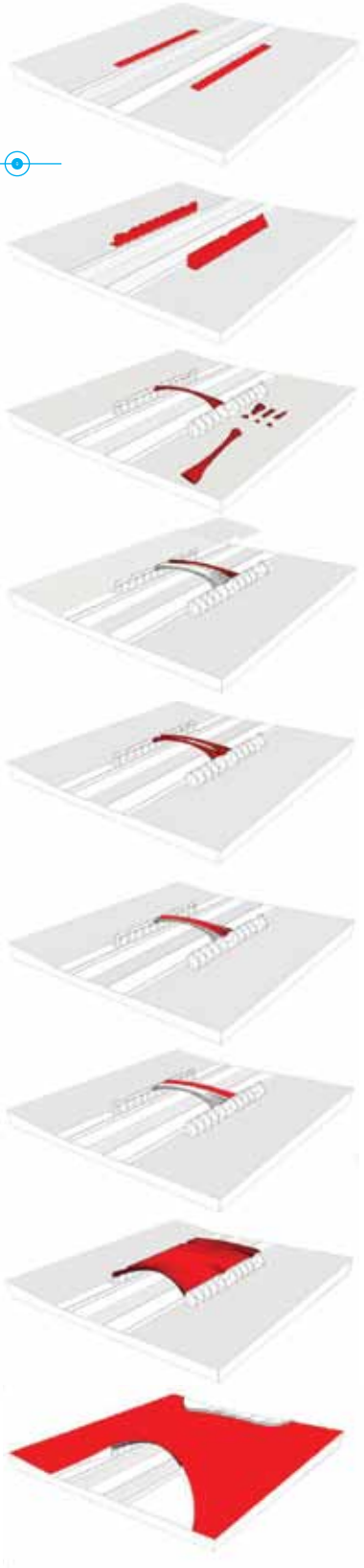


**BALMORI ASSOCIATES** (NEW YORK) WITH STUDIOMDA, KNIPPERS HELBIG INC., DAVID SKELLY, CITA, BLUEGREEN, JOHN A. MARTIN & ASSOCIATES, AND DAVID LANGDON

# MCS—MODULAR CROSSING SYSTEM

The team's Modular Crossing System is designed to be adaptable and easy to install. "It's a tool to create a future network of bridges," Diana Balmori, the team's leading principal, said during the presentation. She and her colleagues describe their entry as a methodology rather than a design per se. The process envisions an analysis of the movements of existing animals to determine the placement of the crossing, and the prefabrication of an overpass's elements off site from locally harvested kill wood. The structure would take the form of a wide continuous beam, eliminating the need for joints or supports in the roadway. The team says the components could be transported in a standard tractor-trailer and installed quickly without shutting down the freeway.

Each crossing would be designed to blend visually and texturally into its surroundings. The plant palette would be based on local flora. After studying the research, the team agreed that width was a crucial element for any successful crossing, and that any structures designed under the system should be at least 50 meters wide to promote the safe passage of a diverse array of species. To make sure a crossing is working optimally, motion-activated heat-sensitive cameras would record animal movements to allow additional analysis that would inform future installations. ●



**RIGHT**
The crossing structure is designed as a wide continuous beam without any joints for strength and durability.

**BELOW**
It would be built from locally harvested wood, layered to support varying loads of soil and plants.

**IMAGE CREDITS**
Courtesy ARC Competition

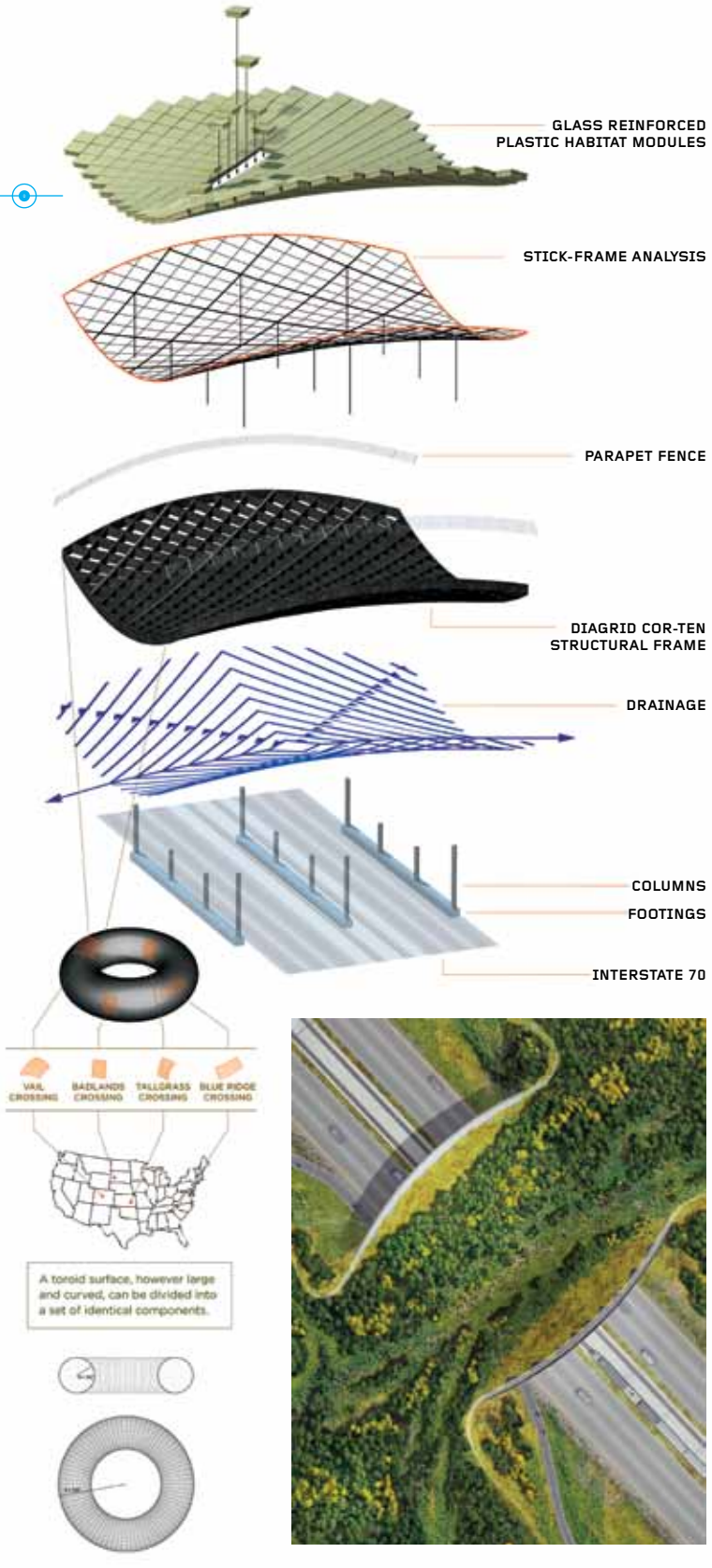
**OLIN** (PHILADELPHIA) WITH EXPLORATIONS ARCHITECTURE (PARIS), BURO HAPPOLD (LONDON), AND APPLIED ECOLOGICAL SERVICES

## WILD (> <) ING

The OLIN-led team drew on that firm's considerable experience designing landscapes over structures such as buildings and parking garages. To promote adaptability, the design envisions a system of crossing structures based on a master form in a toroid, or doughnut, shape, from which a large variety of smaller forms comprising a grid of rhombus-shaped cells could be cut, allowing for differences in topography and scale. The concave, saddlelike shape of a crossing structure derived from this kind of model would reduce vibration and sound effects while remaining essentially open, says David Rubin, ASLA, of OLIN. "It's less a tunnel, more of an event for both animals and drivers," he said at the presentation.

The structural grid would support a smaller-grid lattice, and each cell in that smaller grid would be planted with a glass-reinforced plastic insert filled with layers of insulation, lightweight fill, drainage material, soil, and plants—like a more complex version of a green roof modular tray. This modular approach would allow for easy adjustment in response to shifting wildlife patterns.

The design for the West Vail Pass crossing would include six habitat types: spruce and fir forest, xeric shrubland, mesic shrubland, wet meadow, mesic grassland, and xeric grassland. Visitors could take in the view, as well as delayed video feeds of animal crossings, from an observation platform. ●




**DRAWINGS**
The grid structure and modular planting approach make this design adaptable.

**RENDERING**
The planting plan includes six distinct habitat types.

**IMAGE CREDITS**
Courtesy ARC Competition

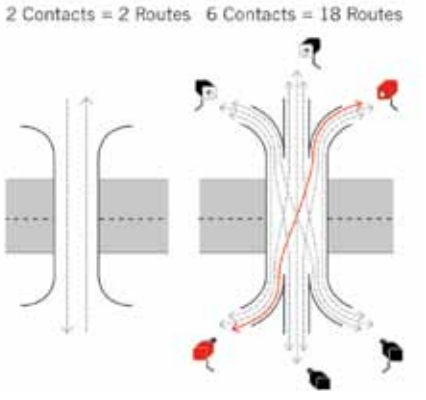
**JANET ROSENBERG + ASSOCIATES** (TORONTO) WITH BLACKWELL BOWICK PARTNERSHIP, DOUGAN & ASSOCIATES, AND ECO-KARE INTERNATIONAL

## RESEARCH EVOLVE DESIGN

The design by this team stands out, and not just because its structural elements are red. Instead of a single wide landing at each side of the overpass, three narrower landings, or "strands," extend deeper into the habitats on either side of the road. Working with the team's ecologist, Kari Gunson, and the animal scientist Temple Grandin, the designers tried to replicate the animals' existing patterns of movement. "We're trying to pick up cues from habitat rather than trying to re-create habitat," says Rosenberg.

The design allows for tree planting in undisturbed soil in the voids between the strands. With this approach, less soil, supporting a simpler plant palette, is required on the crossing structure, reducing its loading requirements.

About that red: It's the cladding of the wood-core fiberglass used for the barrier panels along the edges of the strands and bridge structure. The bright color pops for humans, drawing attention to this new kind of landscape element, but reads as gray to other mammals, blending into its surroundings. Rosenberg says the team chose this material, available in a range of colors, because it's strong, lightweight, durable, and easy to install. ●




**ABOVE RIGHT**
This design reaches deeper into the existing habitat to extend existing "strands" of movement used by animals.

**RIGHT**
Bright red fencing catches the human eye for branding and education but reads as gray to most mammals.

**IMAGE CREDITS**
Courtesy ARC Competition

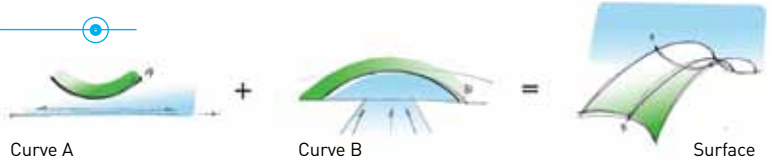
ZWARTS & JANSMA ARCHITECTS (AMSTERDAM) WITH **OKRA LANDSCAPE ARCHITECTS,** IV-INFRA, SJEF JANSEN PLANECOLOGIE, ARCADIS US INC., BATES ENGINEERING, INC., WITTEVEEN + BOS, AND ETH ZÜRICH.

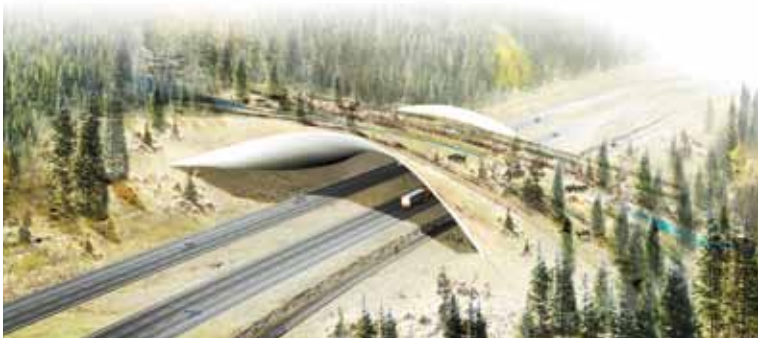
# LANDSHAPE

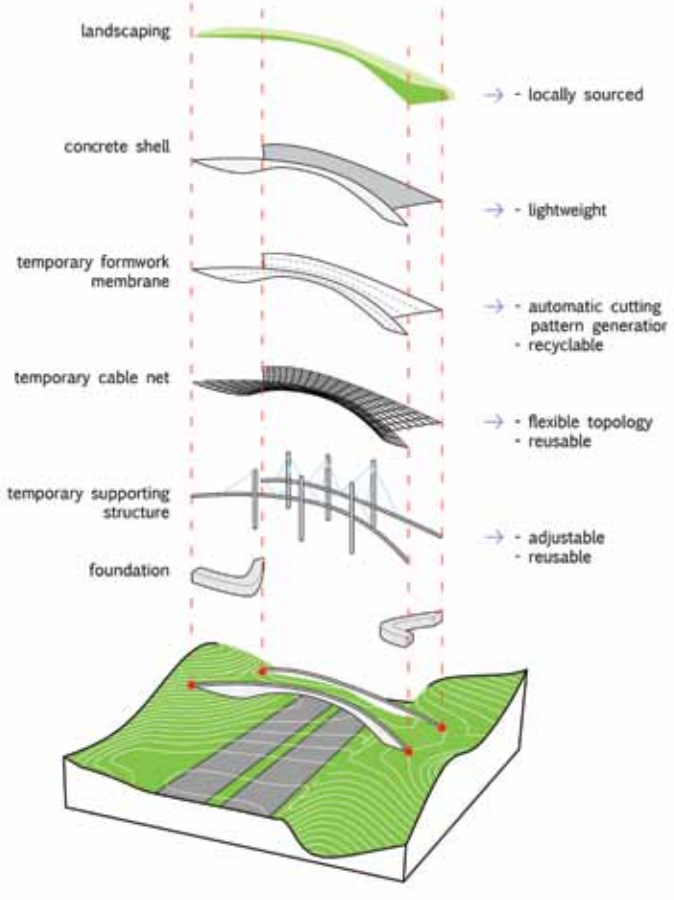
This team, led by the Dutch firm Zwarts & Jansma Architects (ZJA) working with OKRA Landscape Architects, has experience designing wildlife crossings—ZJA designed a crossing in Rijssen in 2003, and the two firms collaborated on nine crossings for Veluwe National Park in 2007.

Their competition design organizes around a system of curves in a hypar or saddle form that follows the natural curves of the site but is adaptable to different topography. The structural engineering is high-tech: A lightweight concrete shell would be cast in place on a temporary formwork and support system, the components of which would be reusable or recyclable. But the landscape elements, including dry-stone walls and rough-hewn poplar fences, are humble and natural; the biodegradable fences are designed to disappear eventually, after animals become accustomed to the crossing route.

The landscape for the West Vail Pass site includes a stream and two small ponds on the structure to collect snowmelt water and attract animals. Its plant palette is dominated by low-growing varieties. "For elk and mule deer, openness and overview are essential to safe passage," says Sjef Jansen of Planecologie. "[We designed] a half-open vegetation situation whereby the animals can safely take passage and see possible predators from a distance." ●






**ABOVE**
The simple curving design can adapt to different situations.

**RIGHT**
Forms are reusable, and the crossing can be built without disrupting traffic.

**IMAGE CREDITS**
Courtesy ARC Competition