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Disaster-resistant Homes Save Money

Building for Resilience

Project Profiles

Iyer Residence

When wildfire swept through Santa Rosa, California, in 2017, it claimed 8,900 structures — including the home of Bala and Lila Iyer. The couple faced a devastating choice: rebuild with conventional methods and risk losing everything again or find a more resilient solution for their fire-prone location on the Rogers Creek Fault line.

Their answer was a 3,717-square-foot residence built with IntegraSpec. Completed after 168 weeks of construction, the ICF installation was 520 days. Nicholas Nikiforuk, who provided ICF support and architectural services, estimates they saved 1 month of time and $15,000 by building with ICFs. ICF and concrete were employed from the footings to the roof on this project.

The Iyer Residence represents one of the most comprehensive applications of ICF technology ever attempted, utilizing 23,548 square feet of ICF materials throughout the structure. Every element — footings, walls, floors, roof, retaining walls, elevator shaft, and even decorative features — was constructed using IntegraSpec ICF and Insul-Deck systems. The residence features 100% ICF exterior walls totaling 5,110 square feet, with an additional 1,200 square feet of interior ICF walls. The structure includes 2,479 square feet of Insul-Deck ICF flooring with 2-inch EPS underslab insulation throughout the 3,717-square-foot conditioned space.

Photos courtesy of IntegraSpec

Beyond the primary structure, the project incorporated ICF technology for specialized applications including 4,602 square feet of roof decking, 4,116 square feet of retaining and landscaping walls, a 462-square-foot elevator shaft, 600 square feet of stairwell construction, and 1,262 square feet of ICF footings.

Site Considerations

The home's design maximizes natural lighting through strategic room placement and multi-angled wings, accommodating the owners' desire for windows in every

room while working within strict 20-foot side setbacks and 25-foot front setbacks mandated by city and HOA requirements.

The hillside location presented immediate challenges that would have deterred many contractors.

"The project site is situated on the edge of a hill. The sub-terrain was all volcanic slag rock and huge boulders," Nikiforuk notes. "The previous house had burned in the 2017 fires in Santa Rosa and the site had been cleaned up to remove contaminated soil and debris by the insurance company and FEMA."

Initial excavation required aggressive rock hammering through volcanic slag rock using heavy machinery, a time-consuming process that was essential for establishing proper grade elevations. The rocky terrain yielded both obstacles and opportunities — excess boulder material was repurposed for hillside rock walls and stairs, demonstrating sustainable site management.

Weather conditions added another layer of complexity. Summer temperatures reached triple digits, requiring pop-up tents for workstations. Winter brought extreme precipitation, while the hillside location sometimes generated wind conditions of 50 to 70 mph, necessitating careful bracing of ICF walls and material securing.

The post-fire reconstruction boom in Santa Rosa created supply chain challenges. "Product availability was becoming a problem," Nikiforuk explained. "The owners had to deal with 8-month delivery for appliances, getting in the queue for kitchen and bathroom cabinets, availability of sub-trades when each phase was ready for them."

Complexity

The architectural complexity of the Iyer Residence challenged ICF technology. The structure features 39 90-degree corners, multi-angle corners, six tee walls, two curved walls, and 45-degree corners — each requiring precise execution and innovative forming techniques.

"IntegraSpec has pre-made 45-degree corners that easily assemble to save time," Nikiforuk noted. "The multi-angle

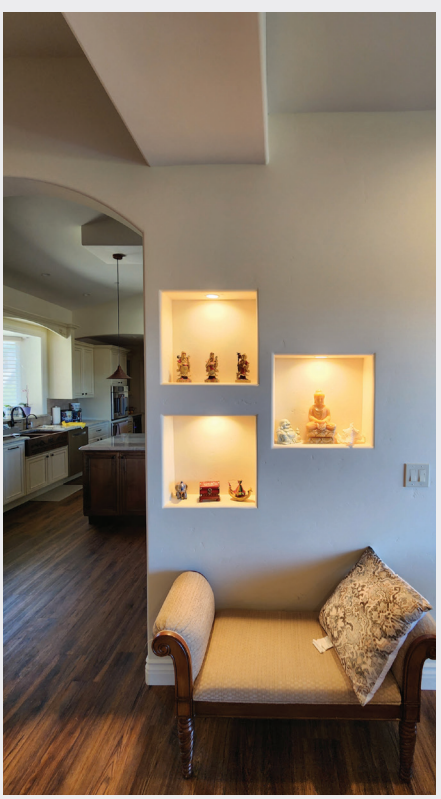
corners were accomplished by cutting the IntegraSpec independent panel on a compound miter saw to the correct angle then butt ending the cut and using perforated pipe strap to close the seam."

Curved walls presented unique challenges solved through innovative field techniques. "The IntegraSpec independent panel is the perfect solution to accomplishing curved walls," Nikiforuk said. "The inside of the panel can be kerfed on the jobsite 1 inch deep every inch on a radial arm saw which makes the panel totally flexible without compromising the strength."

The project's most ambitious element — a 4,602-square-foot InsulDeck ICF roof with multiple pitches, intersecting vaulted dormers, circular skylights, and cantilevered overhangs — required marriage between IntegraSpec and InsulDeck ICF systems. "Several contractors and designers turned down the challenge as it was too difficult for them to execute," Nikiforuk said. The entire roof was poured in a single day, representing a masterpiece of coordination and execution.

Seismic requirements added another layer of complexity due to the Rogers Creek Fault location. The crew prefabricated more than 30 moment frame column cages, each consisting of 10 vertical #6 rebar with horizontal stirrups every 6 inches. "A plywood template was used to keep the cluster spacing consistent and was slid up the cage as the ICF walls were assembled around them."

ICF footings ranging from 5 to 12 feet wide were formed using innovative techniques. "Cutting a panel in half horizontally allowed the installer to stack the panels (full panel and half panel) to create the 18-inch high form required," Nikorofuk said. "The rebar cage was assembled first then using an IntegraSpec web spacer inserted into the girder truss stud that is integral with the IntegraSpec ICF panel the panels were connected to the rebar cage creating the forming necessary to dam the concrete. No other ICF system can do this and it is a lot cheaper than conventional forming and stripping."



Sustainability

The Iyer Residence achieves Net Zero energy performance through what Nikiforuk calls a "Passive Geo Thermal" design approach. "The entire building structure is made of ICF technology including the ICF footings, ICF walls, ICF floors, and ICF roof. There is EPS insulation under the slab on grade. The footings are in contact with the ground source temperatures that are around 60 degrees."

This comprehensive ICF envelope creates what he describes as "a complete closed-circuit thermal highway" that maintains constant building temperature without mechanical devices. Solar panel installations offset electrical consumption, but the building's thermal performance exceeded expectations. While preliminary analysis projected monthly energy bills around $69, the actual result was zero due to the passive geothermal design.

Fire resistance received special attention through material selection. The base stucco coat uses U-Stucco made with volcanic fly ash. "The properties of this product are total fire resistance and will not transfer heat through its layer like Portland stuccoes do," Nikiforuk explained. This provides additional protection against wildfire heat transfer to the structural shell.

The concrete floors incorporate radiant heating with PEX tubing connected to high-efficiency heat pumps. "Once the concrete slab is heated to the comfort temperature the concrete slab acts as a hot plate and maintains the comfort temperature for a week after the heat is turned off," according to Nikiforuk.

Beyond energy efficiency, the ICF construction provides multiple resilience benefits. "The structural benefits are that the building is earthquake-proof, termite-proof, mold-proof, fireproof, hurricane-proof, tornado-proof, soundproof and tsunami-proof. It is the most sustainable structure for all natural disaster conditions."

Significance

The Iyer Residence serves as a demonstration project for comprehensive ICF application in extreme conditions. Located in a Wildland-Urban Interface Fire Zone that has experienced major fires, the project addresses critical resilience needs for communities facing increasing wildfire risk.

"IntegraSpec attended numerous town and HOA meetings to present the features and benefits of ICF technology to preserve the building shell in the case of fire and earthquakes," Nikiforuk reported. The project site became an educational venue for builders, designers, architects, inspectors, and city building department officials. Several new projects were secured due to site exposure and tours, including two additional houses with others under discussion.

For the owners, the project represents more than technical achievement. "Losing everything they owned in the fire that destroyed their house they have been humbled and appreciate and respect life in a different light," Nikiforuk said. "They are extremely thankful to have a second chance and want to share their appreciation with the world." ■

Project Statistics

Location: Santa Rosa, California

Type: Residence

Size: 3,717 sq. ft.

ICF Use: 23,548 sq. ft.

Cost: $3 million

Total Construction: 168 weeks

ICF Installation Time: 520 days

Fast Facts

- ICF footings
- ICF concrete multi-dormer roof
- ICF cantilever overhangs
- ICF cistern for water harvesting
- ICF elevator shaft
- ICF retaining walls and fencing

Visit *www.icfmag.com/project-profiles* for more photos of this project.