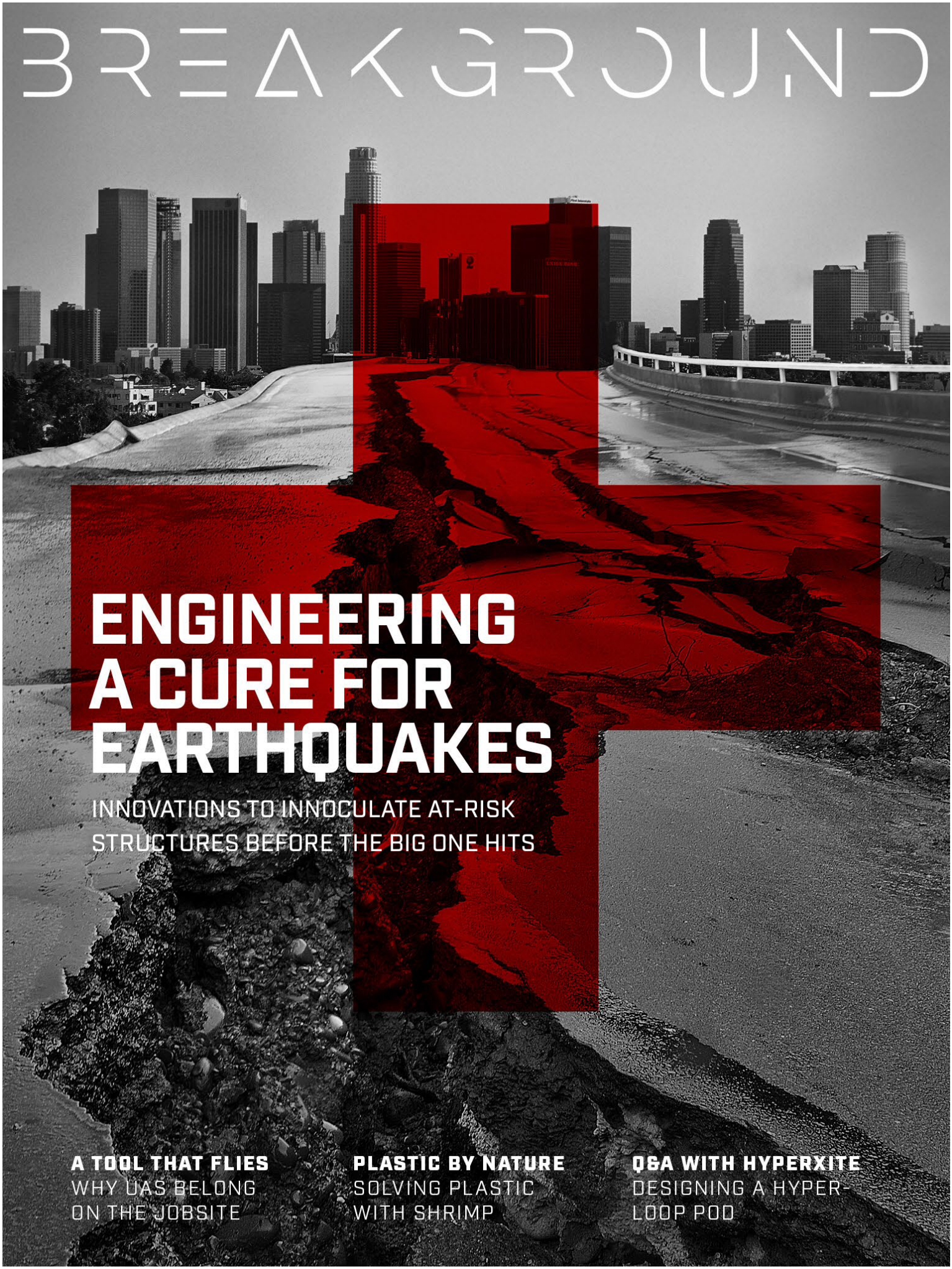
BREAKGROUND



ENGINEERING A CURE FOR EARTHQUAKES

INNOVATIONS TO INNOCULATE AT-RISK STRUCTURES BEFORE THE BIG ONE HITS

A TOOL THAT FLIES
WHY UAS BELONG ON THE JOBSITE

PLASTIC BY NATURE
SOLVING PLASTIC WITH SHRIMP

Q&A WITH HYPERXITE
DESIGNING A HYPER-LOOP POD

CONTENTS

JUST ANOTHER TOOL THAT FLIES

THE NEW NORMAL IS ABOUT TO TAKE FLIGHT ON THE JOBSITE

STORY BY: **DAVID PARK** AND **AARON SILVERSTEIN**

“UAVS ARE A TOOL, SOMETHING THAT HELPS PEOPLE DO WHAT THEY DO BETTER, SAFER, AND FASTER.”

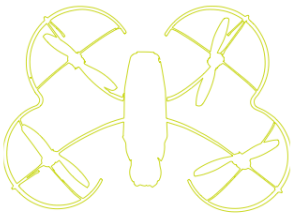
THERE WAS A TIME WHEN FIRM HANDS AND HAMMERS DROVE EVERY SINKER, ONE-BY-ONE, INTO WOODEN FRAMES. FOUNDATIONS WERE DUG WITH PICKS, SHOVELS, AND PERSEVERANCE. STEEL BEAMS WERE HOISTED WITH ROPE, PULLEYS, AND STRONG BACKS.

Then the arrival of nail guns, excavators, and cranes gradually altered the landscape of construction sites. Now so too will the skies above jobsites begin to change, as ever more Unmanned Aircraft Systems (UAS) prepare to lift off. Soon, it may even become quite normal to see swarms of airborne robots autonomously constructing buildings all around us.

Well, let's not get ahead of ourselves just yet.

"There's a way to go before we can have an army of UAVs (Unmanned Aerial Vehicle) erecting a field structure by themselves," says Javier Irizarry, Associate Professor at the Georgia Institute of Technology's School of Building Construction, and the Director of its CONECTech Laboratory.

As we sit in his office on a rainy January afternoon in Atlanta, the energetic academic with salt and pepper hair and a youthful face recalls with a deep voice and Puerto Rican accent the day he first encountered a quadcopter at the 2011 Consumer Electronics Show (CES), "Back then, it was just a toy."



Irizarry has since spent the last five years incorporating that "toy" into his curriculum and researching the plausible applications of the technology for the construction industry. Of course, he wasn't alone in seeing the commercial possibilities of UAVs, or "drones" as they began to be called – despite little resemblance to the infamous military Predators.

In 2012, Congress passed the FAA (Federal Aviation Association) Modernization and Reform Act, which required the safe integration of UAVs into the National Airspace System by September 30, 2015. On the heels of this mandate, Time Magazine published a cover story that in-

troduced a kinder, gentler version of the flying anti-terrorist machine to the wider public as, among other things, the ecommerce delivery droid of the future.

But what could this technology bring to the front door of the construction industry? The answer may only be evident on a jobsite.

Earlier that morning, in a rush I hopped into the back seat of Irizarry's car with a doctoral candidate named Sungjin Kim sitting in the passenger seat and two UAVs stowed in the trunk. We were heading out to a large residential development about one hour north of campus with rain, hail, and snow three hours away from landfall. "You know what happens when you mix electronics and water. Nothing good," Irizarry deadpanned.

Once at the site, Irizarry and Kim quickly put together the aircrafts with practiced ease. Within minutes, they snapped battery packs into place, attached propellers, and began the preflight checklist just 20 feet away from hollering superintendents, clattering jackhammers, and screeching circular saws.

GROUND CONTROL (L)

Remote controls can be synced via mobile app to the UAV

CHECKLIST (R)

Observations are essential before, during, and after a flight

During the drive over, Irizarry had said that "the best laboratory is the jobsite." The notion made perfect sense in that moment. This private space, with so many moving variables and heightened safety measures for existing dangers already in place, was the ideal setting to explore the potential of UAS.

For the exercise, Irizarry was to be the operator and Kim the all-important observer. "Once the UAS is airborne, the observer must keep it and the operator in view at all times," explained Irizarry as he synced his remote control to the DJI flight app on his phone. "Binoculars cannot be

used to substitute or enhance our vision," he stated. "Not even the view from the camera can replace a line of sight." In this way, the three-part "system" in unmanned aerial system was assembled: aircraft, remote control, and human.

After the final check, Irizarry announced, "Starting motor!" The propellers revved up into a dull, whirring buzz. Moments later, he declared, "Taking off!" This time, the sudden burst of four tiny blades simultaneously spinning at top speed sounded like the heart of a hornet's nest. Instantly the aircraft levitated straight up to an altitude of 60 feet. Then, with a nudge of Irizarry's thumb, the UAS leaned forward and swiftly flew ahead 100 feet before stopping to yaw and swing back and forth like a pendulum.

This display realized what was once only imagined. While not yet at the stage where they can manipulate complex objects or carry heavy loads, UAS will be every bit as groundbreaking as the industry hopes – only in very familiar ways.

"Currently UAVs are a tool, something that helps people do what they do better, safer, and faster," says Irizarry back at his office. Like innovations that preceded UAS, the professor believes they have the potential to

enhance human effectiveness and productivity, but people must remain central. "The human factor is the most important aspect of UAS operation. Without the operator, the system would not work."

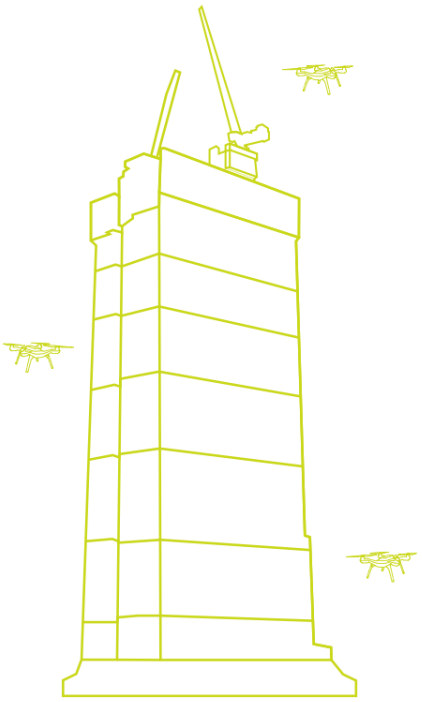
At the command of a safety manager, a UAS could transform a "walk about" into a "fly around" to check on jobsite personnel and identify hazards at multiple elevations in a fraction of the time. Irizarry recalled one instance when a UAS enabled an operator to spot runoff that was contaminating a nearby stream and contributing to erosion. This discovery enabled stakeholders to take action far sooner than a standard aerial survey would have allowed, substantially reducing the negative impact on the surrounding infrastructure.

Unmanned Aerial Systems have already gained industry-wide attention for surveying, encouraging companies that currently perform traditional manned flyovers to do the same with unmanned aircrafts. Late last year, Mortenson Construction drafted its official rules of engagement for integrating third-party UAS operators with FAA 333 Exemptions into their workflows. "We have numerous flights performed with varying objectives, and are seeing a lot of value in improved project planning, project management overviews, and efficiencies in capturing existing and as-built information," says Taylor Cupp, a Product Solutions Technologist at Mortenson.

Unlike full-scale aircrafts, UAS can continuously fly, hover, and rotate in place above a worksite and below the commercial airspace, providing a wider array of angles that can be made available to onsite and offsite stakeholders in real time via Wi-Fi. Analyzing and transforming those raw images and video is the next foothold. Cupp thinks that mapping a photogrammetric model using point cloud data collected via a single UAS flyover can streamline the Building Information Model (BIM) workflow, as opposed to the current method of repeatedly surveying and then updating the model. "I can perform a flight, feed the .obj (object file) of point clouds into Revit and have an as-built model geolocated to my real-world conditions the next day," he explains, adding that the process will "improve safety, speed up decisions, and elevate the overall quality of deliverables."

With the right regulatory environment in place, advances in UAS technology and applications could very well accelerate through more widespread commercial adoption. Irizarry hopes that his research contributes to an industry-specific body of knowledge that ensures future policy reflects this need. "The FAA is developing regulations through what they collect and what they know about aviation, not about specific industries and applications. Of course, Amazon and Google have strong lobbyist groups, but more representation is needed from the construction industry." Once ingenuity is buoyed by the need for competitive advantage, even the sky will no longer be the limit.

When Irizarry said that there's still "a ways to go" toward developing advanced UAS capabilities, it was a reminder of the proverbial need to walk before we run. But within that reality is the promise of a grander destination in the distance. Later he added, "It may happen off-planet before it happens here. Perhaps a mission to Mars with a crew of UAVs to basically build the outpost before people arrive." What we learn today, as UAS start to become commonplace as just another tool that flies, could prove critical to the success of such a mission in the days to come.

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