Engineers: lives lost in Mexico quake could have been saved

October 10 2017, by Garance Burke

This Sept. 24, 2017 photo shows an apartment building that was partially destroyed during the 7.1 magnitude earthquake, on Emiliano Zapata Avenue in Mexico City. The eco-friendly apartment building with its wood-paneled balconies and a solar-paneled roof collapsed when a corner column failed, and the flat-slab structure pancaked, said Eduardo Miranda, a professor of civil and environmental engineering at Stanford and global expert on earthquake-resistant design. (AP Photo/Miguel Tovar)

Warm lighting would enhance the wood floors' natural glow, the

developer promised, so when all the custom lightbulbs burnt out, Anahi Abadia and her husband grudgingly drove to Home Depot to replenish supplies for their chic new flat in southern Mexico City.

They had just reached the register when the earthquake hit, shaking the store so fiercely the structure screeched. Minutes later, a text came in from their neighbor: The elegant apartment they had purchased only six months earlier had collapsed, rendering their new home a pile of crushed concrete.

They were among the fortunate: Two women working in their building and dozens more perished on Sept. 19 in structure failures that several prominent engineers now say could have been prevented. Nearly two-thirds of the 44 buildings that fell in Mexico City were designed with a construction method called flat slab—in which floors are supported only by concrete columns—now forbidden in parts of the United States, Chile and New Zealand according to data compiled by a team of structural engineers at Stanford University and obtained by The Associated Press.

Mexico City officials were widely lauded for tightening their building codes after thousands died in the 1985 earthquake. But they left out one crucial reform: a prohibition on the building technique that caused 61 percent of the building collapses in last month's magnitude 7.1 quake, which killed 369 people and blanketed tree-lined avenues in rubble.

"I keep thinking about what would have happened if I had still been in bed that afternoon." said Abadia, 26, who was in her bedroom that morning recovering from thyroid cancer, dreaming of furnishing the home she and her husband moved into in March. "That was where we used to feel safe."

The concrete slabs used to build floors and ceilings can be cast to include some rebar for reinforcement, and give builders greater flexibility in

room layout and allow for higher ceilings.

But in an earthquake, without reinforced concrete walls or lateral bracing to resist forces pushing structures sideways, buildings with that design can move too much. The columns, and connections between the slabs and columns, can easily break, prompting collapse, as was the case at a school where 26 people died, most of them children.

"We have known for 30 years that this system killed lots of people, so why are we still using it?" asked Eduardo Miranda, a professor of civil and environmental engineering at Stanford and global expert on earthquake-resistant design who compiled the data. "The right decision after '85 would have been to completely ban this kind of construction. We could have saved lives."

Abadia's trendy, ecofriendly apartment building with its wood-paneled balconies and solar-paneled roof collapsed when a corner column failed, and the flat-slab structure pancaked, Miranda said. There, the construction method was only the start of the problems: The units were designed by an engineer whose license lapsed, and approved in a borough where auditors previously found illegal construction occurred unchecked.

This Sept. 24, 2017 photo shows an apartment building that was partially destroyed during the 7.1 magnitude earthquake, on Emiliano Zapata Avenue in Mexico City. The eco-friendly apartment building with its wood-paneled balconies and a solar-paneled roof collapsed when a corner column failed, and the flat-slab structure pancaked, said Eduardo Miranda, a professor of civil and environmental engineering at Stanford and global expert on earthquake-resistant design. (AP Photo/Miguel Tovar)

Experts concur that the devastation caused by last month's earthquake in the city of 8.9 million people could have been much worse had the building codes not been so strong, but it also has forced an uncomfortable conversation about their shortcomings. Now, as experts race to toughen standards to retrofit hundreds of damaged buildings, they are grappling with the reality that corruption has allowed hundreds of structures to be built outside the rules atop the soft soils of Mexico City's ancient lakebed.

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After the quake, Abadia and her husband made their way home to find their flat in ruins, concrete and rebar tangled in the parking lot, pieces of Styrofoam filler used in the slabs floating in the breeze. Frantic neighbors gathered to search for a missing mother and daughter-in-law they knew cleaned an apartment down the hall, but the builder never appeared, so residents were left to sketch out their own graphs of the building's structure for rescue crews seeking a safe entry point.

"The two people working in #404 couldn't get out," said Abadia, the scars from her operation still fresh at the base of her throat. "How is it possible that after less than a year after it opened, the building was completely demolished?"

The day after the earthquake, the builder, Canada Building Group, sent residents an email saying that the company was not responsible for the collapse because the earthquake was a "fortuitous event" out of its control.

Little did residents know that the private engineer who designed the building had been working under a license that expired in July 2015, online records show. City officials and the engineer did not return calls seeking further details about the expiration.

And the borough official who heads the department that signed off on the plans the engineer submitted, including the waffle slab construction, reportedly had been suspended for illicit enrichment after an investigation by Mexico City's controller found he failed to report a line of credit on a home and two cars on his income statement. Neither the builder nor the official, Nicias Rene Aridjis, responded to AP's calls or messages but Aridjis has disputed the claim on Twitter.

An audit performed by Mexico City's controller in 2015 shows that the same borough, Benito Juarez, had been rubber stamping construction drawings, allowing unpermitted and illegal construction to sail through its offices.

"It was found that the department of public works and urban development does not have a specific program to administratively verify construction drawings," the audit said.

In this Sept. 24, 2017 photo, Miriam Anahi Abadia, left, and her husband Led Esau Ramirez, pose for a photo in front of their earthquake -damaged apartment building on Emiliano Zapata Avenue in Mexico City. When all the custom lightbulbs burnt out in their new apartment, Abadia and her husband drove to Home Depot to replenish supplies for their chic new flat. They had just reached the register when the Sept. 19 earthquake hit, shaking the store so fiercely the structure screeched. Minutes later, a text came in from their neighbor: the elegant apartment they had purchased only six months earlier had collapsed, rendering their new home a pile of crushed concrete. (AP Photo/Miguel Tovar)

Borough officials did not return calls seeking comment, but previously announced they were investigating possible sanctions against the developer of Abadia's apartment building and planned to file a criminal complaint.

"It will need to be investigated ," said Renato Berron, head of the Institute for the Security of Constructions of Mexico City, a city agency. "It can't be that something so new fell down."

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In the crisis following the 1985 quake, a group of academics, building officials and engineers drafted emergency recommendations to strengthen Mexico City's seismic codes, which were swiftly passed into law.

The committee was under pressure to analyze what caused the collapses and quickly issue new norms, and some architects and builders were opposed to an outright ban on flat slab construction, said Miranda, who was then writing reports that informed the committee.

"There were lots of builders and owners who were not going to be happy that you just stopped their construction," said Miranda, who later went on to serve on Mexico's code committee in the 1990s, and on committees funded by the U.S. Federal Emergency Management Agency. "These things start as technical conversations but then you run into policy and politics very quickly."

The new codes allowed flat slab construction if developers designed the building to be seismically stronger than structures with beams or concrete walls.

Authorities did not pay enough attention to evaluating if existing flat slab structures needed a seismic retrofit, Miranda said.

"It would have been better to have insisted very much about not using flat slab, or using it only it in very special cases," said Roberto Meli, a renowned structural engineer who served on the code committee in 1985, and later headed the National Center for Disaster Protection founded after that quake. "This was not a good solution."

In this Sept. 24, 2017 photo, a police officer stands guard at an apartment building that was partially destroyed during the 7.1-magnitude earthquake, on Emiliano Zapata Avenue in Mexico City. The eco-friendly apartment building with its wood-paneled balconies and a solar-paneled roof collapsed when a corner column failed, and the flat-slab structure pancaked, said Eduardo Miranda, a professor of civil and environmental engineering at Stanford and global expert on earthquake-resistant design. (AP Photo/Miguel Tovar)

The new codes gave more responsibility to a network of private engineers who are hired and paid by developers, and who submit structural plans to borough authorities. In practice, that means private engineers—not government experts—vet projects' structural safety, and even city officials say the process can be vulnerable to corruption.

"Corruption can come in many forms, from the moment someone accepts a bribe to when someone falsifies documents, or fails to present the right structural plans to borough authorities," said Berron. "If the construction rules were implemented as they are written, then this could be avoided. But that hasn't always worked out."

In recent decades, middle-class enclaves close to the city's professional center have experienced vertiginous growth, and a dizzying array of unpermitted helipads and illegal, multi-floor garages have sprouted up between historic neoclassical homes. In the last 15 years, residents of Abadia's Benito Juarez borough and two others nearby have sent in the highest number of complaints about land-use violations to a city watchdog agency.

Now, those same boroughs are home to dozens of damaged buildings that may need to be demolished or require emergency retrofitting, according to data from the Mexican Society of Structural Engineering. Miranda, whose team compiled the data on the 44 collapses through in-person visits and detailed structural analysis, estimates that hundreds of damaged buildings were built with flat slab systems, including some built relatively recently. Some 57 percent of the collapsed buildings had a soft story, a garage or other similar opening on the ground floor, Miranda's data shows.

Meli said he and others on the expert committee will seek to strengthen retrofitting standards first, and early next year may reexamine flat slab, although he is not convinced prohibiting the method outright would have

worked.

Abadia, who is living temporarily at her mother-in-law's apartment on the other side of the vast city, said she hopes shoddy builders will be held responsible.

"We lost everything," she said. "We know an earthquake is an unexpected event. But a new building should not fall down."