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Istanbul Opens World's Largest Earthquake-Safe Building

By [Alexis Madrigal](#)  November 20, 2009 | 2:16 pm | Categories: [Earth Science](#)

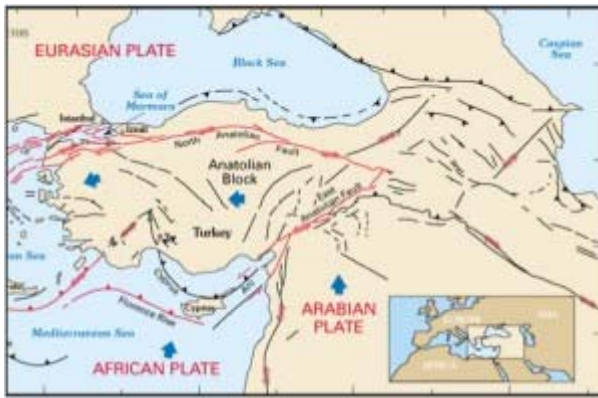


The world's largest seismically isolated building, the new international terminal at Istanbul's Sabiha Gökçen Airport, is now complete and open for business.

Stretching across more than 2 million square feet, the terminal doesn't sit directly on the soil, but rather on more than 300 isolators, bearings that can move side-to-side during an earthquake. The whole building moves as a single unit, which prevents damage from uneven forces acting on the structure.

"What an isolation system does is that it enables the building to move through large displacements in unison, and in doing that, you absorb earthquake energy," said Atila Zekioglu, the engineer at [the firm Arup](#), who designed the building.

Earthquakes accelerate buildings laterally, whipping them back and forth. Isolators (see photo below) slow down the motion of the building. In the case of the new terminal, the building will only have to withstand one-fifth of the acceleration that it would have had to without the earthquake proofing.



A devastating magnitude 7.4 earthquake struck Istanbul on August 17, 1999 killing 17,000 people and causing billions of dollars in property damage. Scientists estimate it's more likely than not that the city will be hit by [another large quake](#) in the next 30 years. Istanbul is located near the confluence of the Arabian, African, and Eurasian plates. The [North Anatolian Fault](#) runs less than 15 miles south of the city. So, like Los Angeles, San Francisco, and a host of other Pacific Rim cities, Istanbul's builders and planners have to take major earthquake precautions.

Luckily, designing structures for that kind of performance has become cheaper and easier. Increased computing enables better simulations of how buildings will act when an earthquake hits.

Zekioglu and his team ran their building designs through 14 different simulations of earthquakes.

"What we have done over the years is that there are many tests going around the globe in terms of shake tables, testing labs, and what we do is we take that data... test the ability of our seismic simulation software," he said.

This software, [called Dyna](#), was originally developed at Lawrence Livermore National Laboratory in the 1970s. It can be used to model what will happen to materials under all kinds of conditions from car crashes to earthquakes to bomb blasts.

The software has allowed engineers like Zekioglu to go beyond simply satisfying the building codes to designing buildings that will really meet the objectives of the structure's owners. You don't just want an airport (or a hospital) to stay standing after an earthquake, you want it to be functional.

The Istanbul project is quite similar to what was done with the San Francisco Airport's international terminal, said Michael Constantinou, a seismic isolation expert at State University of New York at Buffalo, but it uses a newer kind of seismic isolation device.

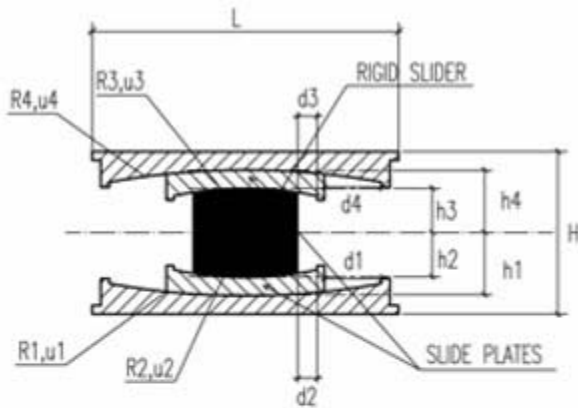
"This is one of the first projects, at the time they started this thing, to use this advancement," Constantinou said.

The new type, triple friction pendulum isolators manufactured by [Earthquake Protection Systems](#) in Vallejo, are more compact and can reduce the cost of constructing a building, he said. Many buildings, including three new hospitals in the San Francisco Bay Area, are now incorporating the new isolators.

Constantinou also highlighted a more general advantage that seismically isolated buildings have: They are actually easier to design because it's very difficult to quantify how and why a structure will collapse.

“You are designing so that the structure will remain undamaged, and that’s much easier to understand,” he said.

The new terminal is designed to withstand an earthquake as strong as 8.0.



Images: 1) The new terminal/ARUP. 2) Seismic situation near Istanbul/USGS. 3) The triple pendulum slider/ARUP.

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Comments (14)

Posted by: efecan | 11/20/09 | 7:35 pm

Way to go, Turkey!

Posted by: CityZen | 11/21/09 | 1:54 am

Istanbul? Not Constantinople?

Posted by: oraj | 11/21/09 | 10:36 am

We need more of these tho, this only one building. And no it hasn't been Constantinople for some time now.

Posted by: stoffer | 11/21/09 | 11:06 am

@oraj - it hasn't been Constantinople for ages 😊

Posted by: rbarnes60 | 11/21/09 | 12:03 pm

CityZen - Don't worry, while other commentators here don't "get" your comment. I do.

Been a long time gone, Constantinople..



Posted by: vachi | 11/21/09 | 12:21 pm

@CityZen yeah 😊 Constantinople, well if i could change all the maps i would, Istanbul just sounds so stupid to begin with, sorry to all the people who think it sounds good lol, to me it sounds like "instant bull"

Posted by: dajoe | 11/21/09 | 1:56 pm

That's nobody's business but the Turks. Instanbuuuuuuuul.

Posted by: bilbawbaggins | 11/21/09 | 4:13 pm

I had a date in Constantinople. Turned out she was waiting in Istanbul.

Posted by: HarryTuttle | 11/21/09 | 6:32 pm

I saw what will happen in 2012. Even this airport can't survive that. They must make it tsunami proof, and I'm talking really big tsunamis. I mean Noah's Ark big.

The end is nigh!!!

Posted by: Sahstar | 11/22/09 | 12:44 am

@CityZen,oraj etc in case you are unaware both Constantinople and Istanbul are Greek compound words.Constantinople consists of two words : Constantin(Κωνσταντίνος) and poli(πόλη=city).So Constantinople simply means "City of Constantine".

Istanbul consists of three words : Is(Εἰς=to),tin(την=the) and poli(πόλη=city),so it literally means "To the City".

At the days of the late Byzantine/early Ottoman Empire the greek language was the lingua franca,much as today the English language is.So it was natural for the Turk conquerors of the City to call it also in greek but in their own way.

So,dear dajoe,I being a Greek have absolutely no problem that your people altered the City's original name since it still has a fully greek name.

I even call the City Istanbul myself sometimes 😊

Unfortunately many Greeks ignore this historic fact and are pissed thinking that you removed the City's original greek name and changing it with a turkish one,which is clearly not the case here.

Actually the only difference is that the City no longer has an international greek-*orthodox*

(St.Constantin was both the last Roman emperor and first Vyzantin emperor) name,just a simple greek three short word compound name.

Posted by: oraj | 11/22/09 | 5:38 am

@Sahstar, firstly I have no intention of turning this into a polemic or anything. But if we are going to go deep down in to the origins, considering I have taken a lot of courses on "Byzantine" and "Constantinople" I know some facts myself. Firstly the "Byzantine" never called themselves that. It was a name given to the civilization by archeologists. The word comes from the greek colony of Byzantium located close to the city. So the Romans referred to the city simply as "Neo Roma", new Rome or simply "the city". I agree with you on the "To the City" issue, Ottomans probably heard that from the people living in the region. Yes I think it's stupid that people get pissed because of this as well. Most of the names we use today aren't originals anyways.

P.S I think "Constantinople" sounds better 😊

Posted by: liquid | 11/22/09 | 11:09 am

istanbul is the most beautiful city in the world, why?

because two continents connecting over that city, it's a little bit crowded, but this crowdness is making city more beautiful,

you can meet very warmblooded people everystep you took in the streets,

think to come here and see some great places!!

don't go back before visiting CAMLICA HILL and across the continent with a ferry, and must to see ISLANDS

and for everyone, maybe constantinople is looking good but show some respect and call my city with ISTANBUL ,thanks.

Posted by: samnigel | 11/22/09 | 10:37 pm

This is about the coolest piece of engineering we've seen in a long while!

Posted by: optimusPaul | 11/23/09 | 9:06 am

You all ruined a good bit of humor with history.
