

# neuro

## The ground can melt from under your feet

### STUDY Loose soil in parts of city can liquefy during earthquake, reduce support to bldgs

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**MUMBAI** Consider this: an earthquake of even moderate intensity can liquify the loose soil in some parts of the city and bring buildings crashing down. A new study by the Indian Institute of Technology - Bombay (IITB) says that foundations of buildings need to take soil into account if the structures have to withstand strong ground accelerations during an earthquake.

Soil liquefaction is a phenomenon in which cohesionless soil — usually sand or clay — flows like muddy water (see box). The study observed that reclaimed areas of the city will be more prone to liquefaction.

A seven-member team simulated pile design or foundation, which can withstand different earthquake magnitudes depending on different soil conditions. "We are trying to find out the simplest formula to design foundations of buildings in terms of piles under earthquake circumstances," said professor Deepankar Choudhary, civil engineering department. "Earthquake codes were last changed in 2002. Since then, many new earthquakes have taken place. Therefore, we need revised codes."

The Mumbai region, which includes Thane and Navi Mumbai, falls under moderate seismic zone 3 with a possibility of earthquake between 6 and 6.5 magnitude. There are 22 fault lines that can cause ground motion in and around the city. According to the study, Mumbai has the most high-rises in India because of scarcity of land. "All these structures are mostly founded on pile foundation because of typical soft nature of soil strata in Mumbai, which is a typical coastal city," read the paper.

The team collected more than 500 borehole data and soil testing reports from Mumbai from different government and private institutions and consultants. Having developed GIS based seismic liquefaction hazard maps for the city — critical, moderate and non-liquefiable — the team observed that reclaimed areas will be more prone to liquefaction during an earthquake of magnitude 6 and above.

### WHAT IS LIQUEFACTION OF SOIL

Liquefaction is a phenomenon in which cohesionless soil — usually sand or clay — flows like muddy water (see box). The study observed that reclaimed areas of the city will be more prone to liquefaction.

It affects the water-saturated sandy layers of the soil. This water exerts a pressure on the soil particles, which influences how tightly they are pressed together.

### NORMAL PRESSURE

The water pressure between soil particles is relatively low. They can maintain strength because of friction from the grains touching.

### INTENSE PRESSURE

An earthquake causes the water pressure to increase to the point where the soil particles can readily move. The water breaks the friction in the grains and fills the spaces, causing liquefaction.

### TYPES OF SOIL IN CITY

Location	Soil Class
LES Marg to Ghatkopar	Stiff soil
Chokala	Stiff soil
Subhash Nagar to Andhri	Stiff soil
Chokala to Airport Road	Stiff soil
Chembur	Soft soil
DLI Nagar Yard	Soft soil
Sakinaika to Vile Parle	Soft soil
Mahim	Very dense soil and soft rock
Andhri	Stiff soil
Lower Parel	Stiff soil

(Soil class according to the National Earthquake Hazards Reduction Programme)

### TYPES OF SOIL IN CITY

Location	Soil Type	Soil Class
Andhri	Stiff clay	E-D
BKC	Black marine clay/Silt clay	E-D
Charli Road	Stiff clay	D
Chembur	Stiff clay	E-D
Tubular chowk	Very stiff yellowish brown silty clay with gravel	E-D
Vikhroli	Yellowish hard Marum	E-D
Wakheswar	Backfilled soil	D
Azad Nagar	Filled up soil consisting of silt clay with gravel	E-D
Girgaum	Yellowish loose sand	E-D
Goregaon	Yellowish clay soil	E-D

(Soil class as per the National Earthquake Hazards Reduction Programme)

"As the city originated from seven different islands, the reclaimed land can easily liquefy in the event of a major earthquake. In the absence of a proper soil exploration, the buildings will get damaged," said Choudhary. A similar study in 2010 revealed that the level of safety of structures in case of an earthquake will not be the same, and depends on the soil quality. In fact, between magnitudes of 6.5 to 7.5, soil in Bhandrup and Malvani in Malad will liquefy faster compared to

Dahisar or Borivli, where liquefaction will occur between magnitudes of 7 to 7.5 on the Richter scale. "Although Mumbai looks safe, it is not. The manner in which high rises are constructed in the city, I hope precautions are being taken to make earthquake-resistant buildings," said V.K. Joshi, former director, Geological Survey of India. "A micro-seismic zonation of Mumbai will bring out area specific vulnerabilities based on which buildings must be constructed."



**VULNERABLE MUMBAI** A magnitude of more than 5.5 on the scale is considered as an earthquake as it causes structural damages

Mumbai is located in peninsular India that comprises Dharwad, Aravalli and Singhbhum proto-continents with high seismic activity at their intersections. A part from Mumbai, soil liquefaction maps have also been prepared for Delhi, Bhopal, Bangalore, Gombathi and Chennai.

## Is your building quake resistant?

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**MUMBAI** With high rises dotting the skyline and little open space to escape, will Mumbai be able to withstand a quake like the one that hit Nepal on Saturday or that of the country's financial capital Odisha like a pack of cards? Who knows? Yes, builders then claim the structures are safe.

The Bureau of Indian Standards does not have a code that governs high rises with regards to earthquake resistant structures.

According to Sandeep Shah, country head, Myamoo

A spokesperson from Tata Housing said they research the area and the site before starting construction. "All Tata Housing structures are compliant with the necessary requirements for earthquake proofing," the spokesperson said.

Subodh Runwal, director, Runwal Group said, "We use more steel than required and adopt stringent measures. Our buildings are all earthquake resistant."

Experts say while the big builders take precautions on the buildings can withstand earthquakes, certain extent, the smaller developers ignore norms. The civic body, meanwhile, has carried out only cursory check the resistance of existing structures.

Sandeep Deshmukh, additional municipal commissioner, said, "When the building plans are submitted for approval, the structural engineers take into consideration the seismic resistance of the building. As for dilapidated structures, we carry out inspection."

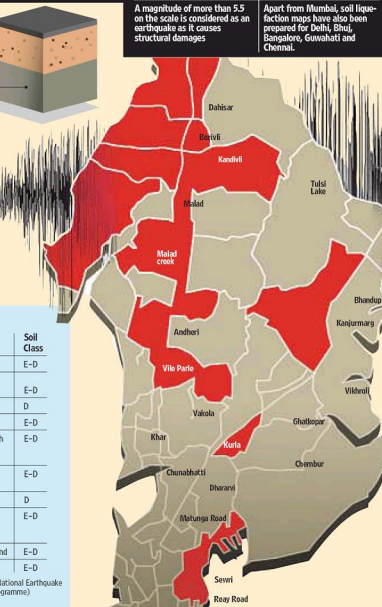


ILLUSTRATION: RAJ KADAM

The critically liquefiable areas (in red) in Mumbai during an earthquake magnitude of 7.

## State plans risk assessment to check disaster readiness

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**MUMBAI** To be prepared in case of any natural or man-made disasters in the state, the government has set up emergency operation systems at district and state levels, and has also decided to go for the hazard vulnerability risk assessment programme that can help in quick response.

The programme, which will be supported by the Geographic Information System (GIS) platform, will be implemented in three disaster prone districts on pilot basis in the next few months.

"All information related to the topography, demography, population of an area, and its economic and social standing will be assessed under the programme. The GIS platform will help us access the information during an emergency," said Shri Dinesh Dikshit, director, disaster management unit.

It will be undertaken in Satara, Pune and Kolhapur, which have witnessed earthquakes, landslides, flooding and other natural calamities in the past few decades.

The state has decided to appoint an independent agency to complete the assessment in the next six to eight months. "A similar programme was implemented in 1993, but the situation has changed in the past two decades and we need to revisit the plan," said an official from the disaster management unit.

The state government has been receiving flak for not setting up the emergency operation and coordination centres in the past two years. "This is because we don't have companies with enough expertise on various forms of disaster mitigation," the official said.

"The centres are expected to coordinate between the agencies involved during any emergency, such as terror strikes, floods, earthquakes, landslides, etc. The administration claims it did not get response despite inviting bids from global players.

That the government had not appointed a company of the State Disaster Response Force (SDRF), although the state Cabinet gave its approval last year.

## 800 tourists from state in Nepal, 30 still missing

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**MUMBAI** More than 800 people from the state are stranded in Nepal, according to the state government.

Of these, 30 are missing and their relatives have been in constant touch with the state authorities.

According to officials of the 1,000 tourists who were in Nepal on Saturday 19 had returned to Maharashtra safely.

"The others are still in Kathmandu and other places in Nepal. All of them are safe and will reach home in the next few days," said Sanjay Dineshwar

## 'Most schools unprepared to handle disasters'

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**MUMBAI** If a high magnitude earthquake were to hit the city, most schools will be unprepared to evacuate students safely, said principals.

Owing to space crunch, most schools are located in multi-storied buildings and do not have a playground or open spaces in their vicinity, where students can take refuge. Moreover, most schools do not conduct mock drills to familiarise students and staff about evacuation methods.

Although the education department — after the 2005 Kashmir earthquake — had advised schools to conduct such drills on a regular basis, hardly any of them have

## DABBAWALAS SHOW THEIR SUPPORT



Mumbai dabbawalas pay tributes to the victims of the Nepal earthquake, at Lower Parel on Monday. KALRA PRAKASH/HT

THERE ARE NO CHECKS BY THE EDUCATION DEPARTMENT TO SEE IF SCHOOLS ARE HOLDING SAFETY DRILLS. THERE IS NO ONE TO CHECK THEIR FREQUENCY TOO.

MILIND CHANDRASKAR, honorary secretary, Maharashtra Gyan Vidyalaya, Sandra

taken these directives seriously. "We have conducted only one mock drill in all these years," said Milind Chindarkar, honorary secretary, Mahatma Gandhi Vidyanidyalaya, Bandra.

Chindarkar added many schools have never even drawn an emergency plan. "In most schools,

the stairways and corridors are so narrow that it could lead to a stampede in such a situation."

In the school curriculum of the state board, disaster management is only a module in the personality development subject for Class 9 and 10. "It is ridiculous that disaster management is given such a small space in the curriculum," said Sachin Dhanrajkar, principal, Indian Education Society's Raja Shivaji Vidyalaya, Dadar.

There is no hands-on training given to teachers or students to deal with emergency situations."

However, the recent earthquakes have forced several schools to think their source on students' safety. "We need to find resource persons to conduct mock drills," said Arunika Bhat, principal, RN Pudar School, Santacruz.

Similarly, Swami Vivekananda International School, Borivli and Goral, has now decided to hold mock drills twice a year. "We held a mock drill after the Peshawar school attacks. Before that, we had never conducted them," said Bipesh Paudyal, director of the group.

An informal group of government educationists have also recommended making safety audits a must for schools, at least twice a year.

## Expedition to Everest base camp cut short for two city women

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**MUMBAI** A 17-day expedition to the Everest base camp, earned after a grueling selection process among thousands of applicants from across the country, has been unceremoniously cut short for two city women, thanks to the deadly earthquake that hit Nepal.

The two — along with eight other women — are safe and expected to return to the city soon.

Goregaon resident Vartika Gupta, along with Poval resident Aparna More, left for the expedition sponsored by a television channel on April 18.

"On April 25, when the first tremors were felt, I received a message on a mobile messaging application that the group was calling off the expedition. I was surprised, but then I saw the size of the disaster on TV. We were horrified, but are relieved that our daughter is safe," said Manisha, Vartika's mother.

Manisha said she was able to talk to her daughter only once a day daily over the phone. "The arrangement decided before leaving for the trip was that the families would be kept informed through a WhatsApp group and a single phone number would be available for the team for occasional calls. Now, all I do is wait for her call," she said.

We could not speak to Vartika or Aparna, as only a one-way communication is possible. Manisha said the group had returned the fourth day of the trek and immediately decided to call off the expedition.



'WILL RETURN SOON'

The trip — sponsored by TV channel — gave 10 women, including Goregaon resident Vartika Gupta (in pic) a chance to trek to the Everest base camp, led by Jiming Norzay, a member of Tenzing Norgay expedition.

"We just spoken with the team at Namche Bivak. They've felt the tremors there, but all seems to be well. Our walkers left from there this morning already and are headed towards now to Deboche (sic)," said a message sent by one of the trek organisers on Monday.

Manisha said her last conversation with her daughter was on Monday morning and that the team was staying in a hotel in Namche. By evening, she was informed that the team had begun to trek down and that they would reach the plains on Tuesday around 10am. "From there, they would be air-lifted to the Kathmandu airport," Gupta said.

The trip gave 10 women a chance to trek to the Everest base camp, led by Jiming Norzay, a member of Tenzing Norgay expedition who first climbed the Mount Everest in 1965 with Sir Edmund Hillary.