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India to up seismometer count five-fold for early earthquake alerts

New Delhi: To reduce loss of life and property caused by earthquakes, India plans to extend its earthquake warning lead time from a few seconds at present to up to 45 seconds, top experts said.

The country will install 1,200 new seismometers to detect fast-moving, non-destructive primary waves (P-waves) at the onset of an earthquake, enabling alerts to be issued before the slower, more destructive secondary waves (S-waves) reach a location, Krishna S. Vatsa, member of the National Disaster Management Authority (NDMA) told Mint.

The country currently has about 300 seismometers at earthquake monitoring stations for detection, early warning capability and scientific understanding of seismic activity.

Scientists and disaster management experts say this brief gap between the arrival of different seismic waves can be used to safeguard critical infrastructure such as metro rail systems, transmission lines, power plants and industrial facilities. While earthquakes cannot be predicted in advance, many countries operate Earthquake Early Warning (EEW) systems that provide a few seconds to about one minute of lead time before strong shake reaches a location.

The development is significant given that 59% of India is vulnerable to earthquakes due to its unique geological and tectonic setting, particularly its location at the collision boundary of the Indian and Eurasian plates.

Mint had earlier reported that India was developing a system to predict destructive S-waves during earthquakes.

According to the Coalition for Disaster Resilient Infrastructure (CDRI), a New Delhi-based multilateral organization, India suffers losses of around $31.6 billion across nine infrastructure sectors—buildings, health,

education, oil and gas, ports and airports, power, roads and railways, telecommunications, and water and wastewater—due to earthquakes, cyclones, floods, landslides and tsunamis every year. Of this, earthquakes account for 5.5% or $1.73 billion.

A seismometer transmits real-time data to central processing facilities, allowing scientists to analyze earthquake magnitude, depth and epicentre. The additional infrastructure will also help scientists detect smaller tremors, better map seismic zones, and develop capabilities similar to those of Japan, where the lead time goes up to 60 seconds, depending on several factors.

By expanding the network to 1,500 seismometers, India plans to create a much denser grid of sensors that will allow more precise tracking of seismic activity.

“Our objective is to detect the occurrence of the P-wave and use that short window to anticipate the arrival of the damaging S-wave," Vatsa said. "The expansion, coupled with an early earthquake warning system, will substantially improve the density and coverage of monitoring stations, enabling scientists to detect smaller tremors and better map seismic zones”

A seismometer costs around ₹6 lakh and records ground vibrations and transmit real-time data to central processing facilities. Although earthquakes cannot yet be predicted precisely, a denser network of sensors allows scientists to detect the first seismic waves more quickly and accurately, improving the speed at which alerts can be generated and transmitted.

“The P-wave travels at about 6 km per second, while the S-wave moves at roughly 3.8 km per second, though their speed varies depending on the medium and distance travelled," said a scientist at the National Centre for Seismology. "If the earthquake’s epicentre is around 250 km away, it provides sufficient lead time to generate alerts. However, when the distance is shorter, the available warning time correspondingly reduces.”

The National Centre for Seismology monitors earthquakes and provides updates on them.

Minimizing the hit
Insurance companies are enthused with the upgrade plan.

“From an insurance perspective, such timely interventions can help minimize secondary damage such as fires, chemical leaks, machinery breakdowns, and infrastructure disruptions, which often account for a significant share of insured losses," said Amarnath Saxena, chief technical officer, Commercial at Bajaj General Insurance. "Over time, the data generated through these systems can also strengthen catastrophe modelling and risk assessment, helping insurers better understand exposure patterns."

India has witnessed several devastating earthquakes, causing significant loss of life and widespread destruction of infrastructure.

One of the deadliest earthquakes in India's recent history was in Bhuj, Gujarat in January, 2001. With a 7.9 magnitude on the richter scale, the earthquake killed an estimated 12,932 people and injured over 160,000 others. The disaster caused economic losses of around $10 billion, making it one of the costliest natural disasters in India.

Earlier, the 1993 Latur earthquake in Maharashtra caused massive devastation despite having a relatively moderate magnitude of 6.2. The quake caused an estimated property loss of around $1.3 billion.

According to CDRI early warning systems powered by real-time data, resilient building codes and standards, adaptive engineering principles, and artificial intelligence (AI) play a vital role in safeguarding infrastructure and communities. They enhance seismic resilience by better equipping assets to withstand shocks, accelerate recovery, and protect lives and livelihoods.

“These systems save lives. They also protect critical infrastructure, such as power grids, transport networks, and communication systems, by issuing timely alerts that allow operators to take preventive actions, like shutting down equipment or activating backup systems," said Amit Prothi, director general at CDRI. "An example is Japan’s earthquake early warning system, which uses EWS to detect seismic waves to reduce potential damage."

With urbanization and infrastructure expanding rapidly in earthquake-prone regions, authorities believe that building a robust seismic monitoring system is essential to improve disaster preparedness and reduce potential loss of life and property. Regions such as Jammu and Kashmir, Himachal Pradesh, Uttarakhand, the northeastern states and parts of Gujarat fall under high seismic risk zones.