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Cowasjee Earthquake Study Centre
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NEWSLETTER

Iran hit by strong earthquake again.

A strong earthquake hit the city of Zarand and several villages in Kerman province of Iran on February 22, 2005. The quake happened at 5:55 local time (2:25 UTC) and was measured at 6.4 on the Richter scale. The quake lasted for 11 seconds and at least 61 aftershocks were reported ranging in magnitude between 3.3 and 4.8. Zarand is located 740 km southeast of Tehran.

Damage and casualties

Though official reports by Iranian authorities indicate 612 dead and 990 injured, ISNA reports 790 dead and 1,423 injured according to officials in Kerman University of Medical Sciences. Four villages, each having around 1,000 inhabitants, were reported completely destroyed, and 30% to 70% of buildings in more than 40 villages were reported damaged.

Affected area

It is estimated that the population of the affected area exceeds 30,000. A great portion of population of several villages are severely affected because of poor condition of buildings. The epicenter of the quake was in a mountainous and sparsely inhabited area. It is believed that the death toll could have been much higher if the quake had stricken a more densely-populated area like Bam.

According to governor of Kerman province and an independent investigation carried out by ISNA the following cities and villages are affected:

Damaged houses in the city of Zarand.

Previous quakes

The region of Zarand is close to an active fault, known as the *Kuhbanan* fault in the north east of the city. Its trend is northwest-southeast and its length is 160 km.Zarand has been hit by several quakes in the last 70 years, with the oldest recorded one going back to 1933.

On December 21, 1977, the area was hit by a 6.2-magnitude earthquake leaving 521 dead and 3 villages completely destroyed. The epicentre of the latest quake is about 200 km (120 miles) north-west of Bam, where some 30,000 people were killed when a powerful earthquake levelled the historic city in 2003.

The casualties in Tuesday's quake could have been far worse had it struck a major city instead of a more sparsely populated area. The focus of this earthquake was four times deeper underground than in Bam, lessening the impact. Iran has at least a minor earthquake almost every day. The United Nations says Iran is the worst-hit country in the world in terms of earthquakes.

Seismologists say this is because Iran is at the confluence of three of the Earth's plates, and is literally being squeezed by them.

Inside this issue:

EDITORIAL

The first issue of volume 5 of CESNED NEWSLETTER in hand is a follow-up to the special edition of December 2004. The devastation caused by the Tsunami as reported in the special edition has scaled to new heights. This issue contains the up-to- date information regarding Tsunami and its after effects in the region. The casualty figures have been updated and information on Tsunami warning systems has been included. The outreach activities of CESNED with respect to needed research in the area of Seismology and seismic design have been incorporated in this issue to replace the regular feature of Earthquake mitigation for wider appreciation.

CESNED is aware of the needs to disseminate knowledge regarding such events and it has always been emphasized that any contribution in terms of articles shall be appreciated by CESNED, however, CESNED have yet to benefit from contributions from outside source, which, however,

Updated Casualty Summary of Tsunami

Country where deaths occurred	Deaths		Injured	Missing	Displaced
	Confirmed	Estimated			
Indonesia	173,981	220,000	~100,000	6,245	400,000- 700,000
Sri Lanka	38,195	38,195	15,686	23,000+	~573,000
India	10,744	16,413	—	5,669	380,000
Thailand	5,305	11,000	8,457	4,499	—
Somalia	150+	298	—	—	5,000
Myanmar (Burma)	59	290 – 600	45	200	3,200 confirmed
Malaysia	68 - 74	74	299	—	—
Maldives	82	108	—	26	12,000 - 22,000
Seychelles	1 – 3	3	—	—	—
Tanzania	10	10+	—	—	—
Bangladesh	2	2	—	—	—
South Africa	2	2	—	—	—
Kenya	1	2	2	—	—
Yemen	1	1	—	—	—
Madagascar	—	—	—	—	1,000+
Total	228,601+	~288,608	~125,000	~40,000	~1.5 million

Note: All figures are as of February 2005 and subject to constant change, taken from various news agencies.

Satellite images of devastation caused by Tsunami

Devastation to Banda Aceh on the island of Sumatra as a result of the tsunami caused by the 2004 Indian Ocean earthquake *(Courtesy: Digital Globe)*

Devastation to Kalutara in Srilanka as a result of the tsunami caused by the 2004 Indian Ocean earthquake *(Courtesy: Digital Globe)*

CESNED Participates in Fifth Conference of Earthquake Resistant Engineering Structures (ERES-2005)

CESNED has established itself as a reputable platform for research in the area of Earthquake Engineering and Engineering Seismology. Apart from disseminating information about earthquakes in general, it has focused on specific issues to carryout research with result oriented outputs. Currently, one such research work is underway, under the supervision of Dr. S .H. Lodi that aims at development of response spectra for the Southern Coastal Region of Sindh. The research undertaking is in the final phase, along with development software to stochastically simulate earthquake accelerogram, performing ground response analyses; and GIS model of Southern Coastal Belt of Sindh; the work has successfully produced research publication of international repute.

The research paper titled "*Prediction of Response Spectral Parameters, for Bhuj Earthquake (26th January 2001), Using Component Attenuation Modeling Technique*", was accepted in ERES 2005, Fifth Conference on Earthquake Resistant Engineering Structures that held from 30th May to 1st June, in Skiathos, Greece, was organized by Wessex Institute of Technology (WIT).

ERES-2005 was fifth conference of the series of Earthquake Resistant Engineering Structures. The conference comprised of more than 70 contributions from renowned researchers in the field of earthquake hazard mitigation issues from all over the world. The conference covered almost every aspect of earthquake engineering which included Earthquake resistant design, seismic isolation and passive protection, retrofitting methods and experiments, monitoring and testing, lifeline and geodynamical considerations.

Mukesh Kumar, Research Assistant in the project, presented the paper in the conference. The paper focused on estimating response of structural systems during Mw 7.7, Bhuj earthquake that occurred in the northwestern fringes of the Indian subcontinent. The event is regarded as one of the most devastating earthquakes of the stable continental regions (SCR). Although the Kutch region has experienced the events of large and moderate magnitude since historic times, yet the estimation of future design basis have remained hampered by lack of ground motion data.

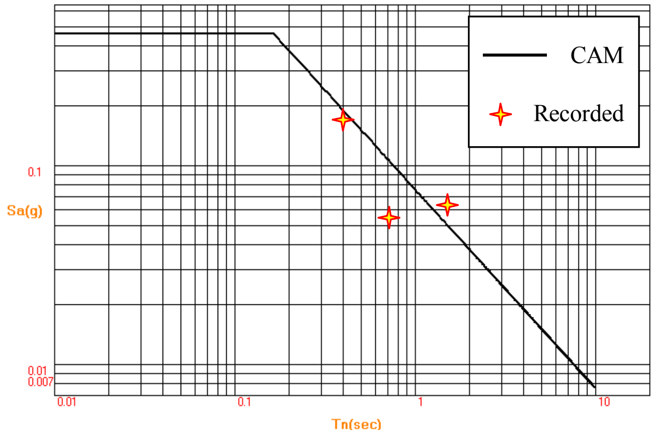


Figure 1: Illustrates the predicted DRS v/s SRR values at the distance of 150 km

A recently developed methodology of Component Attenuation Modeling (CAM) is adopted to estimate the response spectral values. The technique is modified version of the orthodox stochastically based simulation model, and predicts design structural responses directly by adapting local seismological information, for the regions lacking earthquake records. A dataset of 13 Structural Response Recorders (SRRs) stationed at various locations from the epicenter is utilized for purpose of validation, due to absence of Digital Strong-Motion Accelerograph (DSA) records.

The stations are categorized in three schemes Quaternary, Tertiary and Rock; based on NEHRP classification. The wave propagation behavior of the crust is assumed to resemble with Eastern Northern America (ENA), considering the geological setting and wave transmission qualities of both regions.

The observed recordings reconcile well with predictions of CAM in the bandwidth of available time periods. The absence of recordings in velocity and acceleration controlled regimes restricts to assess the performance of the technique in all period ranges.

The research exercise not only helps achieve the design parameters for coastal region of Sindh, but also assesses the applicability of CAM to the regions of low to moderate seismicity. Comparative analysis of two methods; coupled with parametric sensitivity analysis sets future trends in further fine-tuning of CAM. The idea can be prolonged to develop design response spectra for the southern belt of Sindh, which can be used in assessment of seismic analysis of existing as well as future infrastructure.

Tsunami Warning Systems

A **tsunami warning system** is a system to detect tsunamis and issue warnings to prevent loss of life. It consists of two equally important components: a network of sensors to detect tsunamis and a communications infrastructure to issue timely alarms to permit evacuation of coastal areas.

Many areas around the Pacific, notably Japan, Hawaii, French Polynesia, Alaska and the Pacific coasts of South America, have tsunami warning systems and evacuation procedures in case of a serious tsunami. However other oceans do not, and this contributed to major loss of life after the 2004 Indian Ocean tsunami. In the aftermath of this disaster, it is very likely that warning systems will be put in place in the Indian Ocean, Atlantic Ocean and Caribbean, and plans have started for an International Early Warning Programme.

Types

There are two distinct types: international tsunami warning systems, and regional warning systems. Both depend on the fact that, while tsunamis travel at between 500 and 1,000 km/h in open water, earthquakes can be detected almost at once as seismic waves travel with a typical speed of 5 km/s. This gives time for a tsunami forecast to be made and warnings to be issued to threatened areas, if warranted. The first rudimentary system to alert communities of an impending tsunami was attempted in Hawaii in the 1920s. More advanced systems were developed in the wake of the April 1, 1946 and May 23, 1960 tsunamis which caused massive devastation in Hilo, Hawaii.

International tsunami prediction for the Pacific Ocean and early warning is over-seen by the US Pacific Tsunami Warning Center (PTWC) operated by NOAA in Ewa Beach, Hawaii. This centre was established in 1949, following the 1946 Aleutian Island earthquake and a tsunami that resulted in 165 casualties on Hawaii and Alaska. International coordination is achieved through the *International Coordination Group for the Tsunami Warning System in the Pacific (http://ioc.unesco.org/itsu/)*, established by the Intergovernmental Oceanographic Commission of UNESCO.

Regional warning systems

Regional (or local) warning system centres use seismic data about nearby earthquakes to determine if there is a possible local threat of a tsunami. Such systems are capable of issuing warnings to the general public (via public address systems and sirens) in less than 15 minutes. Although the epicenter and moment magnitude of a underwater quake and the probable tsunami arrival times can be quickly calculated, it is almost always impossible to know whether underwater ground shifts have occurred which will result in tsunami waves. As a result, false alarms can occur with these systems, but due to the highly localised nature of these extremely quick warnings, disruption is small.

International warning systems

The international Pacific Tsunami Warning Center also uses seismic data as its starting point, but then takes into account oceanographic data when calculating possible threats. Tide gauges in the area of the earthquake are checked to establish if a tsunami wave has formed. The centre then forecasts the future of the tsunami, issuing warnings to at-risk areas all around the Pacific basin if needed. There are never false alarms — if the PTWC issues a tsunami warning for a particular area, the wave is already on its way and is sure to hit. As it takes more time for tsunamis to travel trans-oceanic distances, the PTWC can afford to take the time to make sure of its forecasts.

Deep ocean tsunami detection

In 1995 the US National Oceanic and Atmospheric Administration (NOAA) began developing the Deep-ocean Assessment and Reporting of Tsunamis (DART) system. By 2001 an array of six stations had been deployed in the Pacific Ocean. Beginning in 2005, as a result of heightened awareness due to the tsunamis caused by the 2004 Indian Ocean earthquake, plans were announced to add 32 more DART buoys to be operational by mid-2007.

These stations give detailed information about tsunamis while they are still far off shore. Each station consists of a sea-bed bottom pressure recorder (at a depth of about 6000 m) which detects the passage of a tsunami and transmits the data to a surface buoy via sonar. The surface buoy then radios the information to the PTWC via the GOES satellite system. The bottom pressure recorder lasts for two years while the surface buoy is replaced every year. The system has considerably improved the forecasting and warning of tsunamis in the Pacific.

Radar detection from space

During the 2004 Indian Ocean tsunami, data from four radar satellites recorded the heights of tsunami waves: at two hours after the earthquake, the maximum height was 60 cm (two ft). These observations, which were the first ever made, will help calibrate and refine tsunami models.

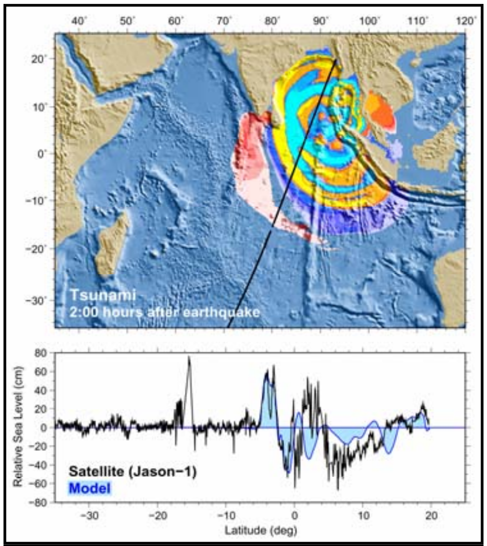
It should be noted that the satellite observations of the Indian Ocean tsunami would not have been of any use in delivering warnings, as the data took at least five hours to process and it was pure chance that the satellites were overhead at that time. However, in future, it is possible that space-based observation might play a direct role in tsunami warning systems.

Conveying the warning

Detection and prediction of tsunamis is only half the work of the system. Of equal importance is the ability to warn the populations of the areas that will be effected. All tsunami warning systems feature multiple lines of communications (such as e-mail, fax, radio and telex, often using hardened dedicated systems) enabling emergency messages to be sent to the emergency services and armed forces, as well to population alerting systems (eg sirens).

Shortcomings

No system can protect against a very sudden tsunami. A devastating tsunami occurred off the coast of Hokkaido in Japan as a result of an earthquake on July 12, 1993. As a result, 202 people on the small island of Okushiri lost their lives, and hundreds more were missing or injured. This tsunami struck just three to five minutes after the quake and most victims were caught while fleeing for higher ground and secure places after surviving the earthquake.



Radar imaging of the tsunami two hours after the earthquake.

While there remains the potential for sudden devastation from a tsunami, warning systems can be effective. For example if there were a very large subduction zone earthquake (magnitude 9.0) off the west coast of the United States, people in Japan, for example, would have more than 12 hours (and likely warnings from warning systems in Hawaii and elsewhere) before any tsunami arrived, giving them some time to evacuate areas likely to be affected.

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Information, news items, short notes on research findings are invited from across the globe.