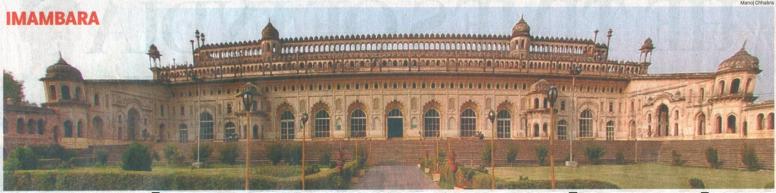
Abhinay Malhotra TNN

Kanpur: In a startling revelation, a study conducted by IIT-Kanpur has pointed out that the 17th-18th century Lucknow masonry monuments like Rumi Darwaza, Imambara, Naubatkhana Dilkusha Kothi and Moosa Bagh Lase a serious threat to their survival from a strong earthquake.

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## **Can Lucknow monuments survive quake?**

## **IIT-Kanpur Study Paints Gloomy Picture** For Rumi Darwaza And Imambara

Abhinay Malhotra ITNN

Kanpur: In a startling revelation, a study conducted by IIT-Kanpur has pointed out that the 17th-18th century Lucknow masonry monuments like the chemical and mineralogi-Rumi Darwaza, Imambara, Naubatkhana, Dilkusha Kothi and Moosa Bagh face a serious threat to their survival from a surface texture, colour, partistrong earthquake.

The Lucknow monuments built using thin 'lakhauri' (burnt-clay bricks) and limecrushed brick 'surkhi' (aggregate) mortars were "seismically evaluated" by Prof Durgesh C Rai of the Department of Civil Engineering, IIT-Kanpur, over a period of three years. His research has also found place on the cover of 'Current Science' (January 25 edition), a fortnightly journal of scientific research

According to Prof Rai, the damage to the Lucknow monuments is likely in the event of an earthquake causing a shaking intensity of 7 or above on Ritcher scale in Lucknow rethe Indian Seismic Code-IS

Talking to TOI, Prof Rai tar and plaster samples from various Lucknow monuments, including renovation plaster sample from Rumi headded. Darwaza, Dilkhusha and Nau-

(TGA), scanning electron microscope associated with energy dispersive spectroscopy (SEM-EDS) and X-ray diffraction (XRD) were used to find cal composition of the material. The brick samples were also examined visually for their cle shape and size."

"Studies were carried out to characterize engineering properties of old masonry materials and new mortar being used for renovation work. The mechanical properties of reclaimed 'Lakhauri' bricks were found comparable to good-quality contemporary bricks of neighbouring regions," he added.

Further, the research found that mineralogical composition of the material was not too different, except for a few minerals. The lime-surkhi mortar used in old masonry work was found to be lime rich with binder to aggregate ratio of about 1:2 to 3 by volume that gion as it comes in Zone 3 of is similar to those used in Byzantine structures of Western and Central Asia.

"As the renovation mortar said: "We collected brick, mor- has poor hydraulic property compared to old mortar, the bricks used then are no different from modern day bricks,'

"The arch and half-dome batkhana Test methods like structure of Rumi Darwaya microwave acid digestion, was analyzed for its seismic

thermo-gravimetric analysis resistance using laboratory determined properties of Lakhauri masonry. The pushover and response spectrum analysis estimated lower seismic capacity in comparison to demand for design-level ground motions, implying likelihood of damage in future earthquakes," said Prof Rai.

The half-dome drum structure, Rumi Darwaza, was studied for seismic resistance since its shape and the materials used for its construction contribute to its uniqueness.

"Work at Rumi Darwaza was taken up by the Archaeological Survey of India (ASI), Lucknow, to repair the damfound in the structure, no sig-compatible

## The study primarily aims at:

 Characterization of materials used in Lucknow monuments, such as Lakhauri bricks, lime-surkhi mortar and plaster and masonry assemblages recreated in laboratory using Lakhauri bricks and lime-surkhi mortars

Seismic evaluation of the half-dome structure of Rumi Darwaza by comparing its present day seismic load carrying capacity with the expected seismic demand using suitable analytical and numerical modeling. For the purpose of material modeling in numerical analyses, masonry properties were obtained from masonry assemblages constructed with reclaimed Lakhauri bricks and simulated lime-surkhi mortars

retrofitting or intervention nal material in the sense that work was carried out." said the IIT-Kanpur scientist According to the latest edition of Current Science, material characterization of historical masonry materials and structural analysis of historical monuments were important aspects of any renovation or age in the structure caused by retrofitting. "The most imporageing, climatic conditions tant aspect considered in the and vibration due to traffic renovation works of historimovement through the gate. cal buildings is that the inter-Though major cracks were vention material should be

it will not cause any damage in the long term. This requires knowledge about the physical properties, mineralogical and chemical composition of original masonry materials as well as various problems arising out of continued deterioration, which our study has pointed out," Prof Rai said.

Asked whether use of for the selection of repair morwrong materials in restoratars considering the requiretion of historical buildings ments of resistance to the enleads to rapid deterioration in vironmental conditions as the whole structure and its well as of compatibility to old constituent elements. Prof. Rai said: "They may lose their

materials," he added. Prof Raisaid IIT-Kanpur is support to ASI for doing renovation of these important monuments so as to fortify them against earthquake and other environmental factors such as rain.

problems they may cause,

on the structure in short and

ble criteria should be adopted

"It is important that suita-

long-term.

Archaeologist (Lucknow Region) Archeaology Survey of India (ASI) Praveen Kumar Mishra, said: "Rumi Darwaza and other masonry monupast 300 years and have passed of our monuments.



sites, there seems to be no leading to undesirable effect threat to the Lucknow monuments He said that he would like to analyze the magnitude of earthquake which can actually damage Rumi Darwaza and

other historical monuments. "I am not aware about the research work done by the IIT-Kanpur scientist and neither read the paper published in the recent edition of 'Current ready to provide scientific Science' journal but a proper conservation of the Lucknow monuments is being done. I will study the research work done by Prof Rai," Mishra added.When questioned whether ASI was ready to take However, Superintending scientific input from IIT-Kanpur for better conservation of historical Lucknow monuments, Mishra said: "I welcome the technological knowhow from IIT-Kanpur. If it is ments in Lucknow have with- provided to us, we are ready to stood climatic changes in the use it for better preservation

