

Webinar On SEISMIC RETROFITTING OF BUILDINGS

12th May 2023 (Friday); 3:00 PM to 5:00 PM

Jointly Organized by



National Institute of Disaster Management
Ministry of Home Affairs, Govt. of India



Seismic Academy

PATRONS



Shri Rajendra Ratnool
Executive Director
National Institute of Disaster
Management (NIDM)
Ministry of Home Affairs, Govt. of India



Prof. Chandan Ghosh
Head Resilient Infrastructure Division,
National Institute of Disaster
Management (NIDM)
Ministry of Home Affairs, Govt. of India

SPEAKERS



Prof. (Dr.) Ajay Chourasia
Chief Scientist and Head of
Structural Engineering & 3D
Concrete Printing Group
CSIR-CBRI, Roorkee



Dr. Hemant Kumar Vinayak
Associate Professor
Dept. of Rural Development,
NITTTR, Chandigarh



Mr. Shounak Mitra
Head-Codes and
Approval
Hilti India Pvt. Ltd., Delhi

CONVENOR

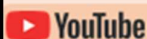


Dr. Garima Aggarwal
Senior Consultant
Resilient Infrastructure Division,
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Ministry of Home Affairs, Govt. of India

MODERATOR



Ms. Avipsha Mohanty
Young Professional
Resilient Infrastructure Division,
National Institute of Disaster Management (NIDM)
Ministry of Home Affairs, Govt. of India



Registration Link: <https://training.nidm.gov.in/>



Stay Protected
from Corona



Wear your Mask
Properly



Follow Proper
Hand Hygiene



Maintain Social
Distancing



Get
Vaccinated



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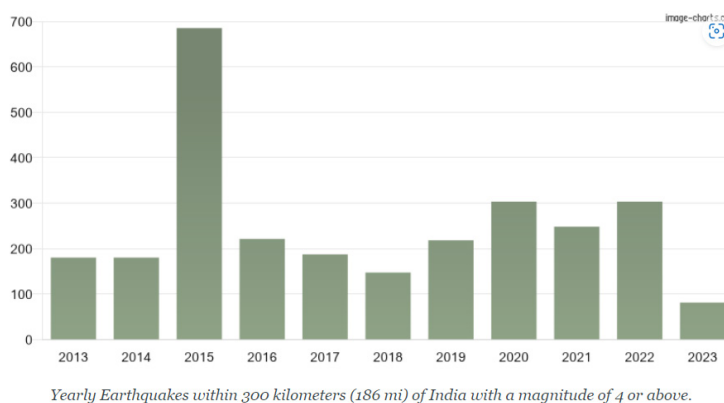
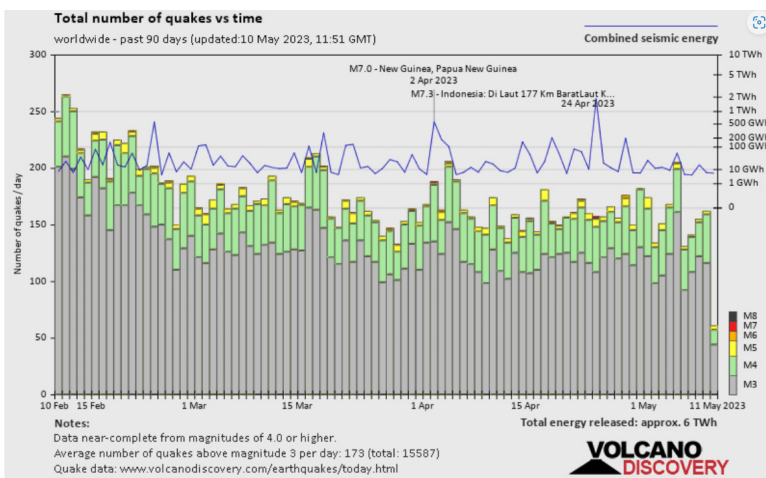
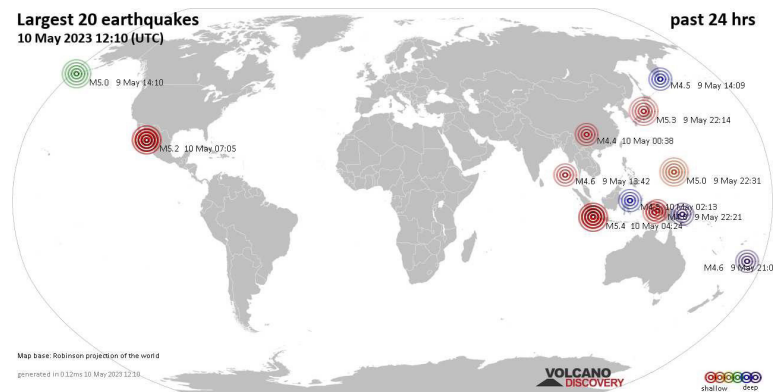
Website: www.nidm.gov.in

<https://www.youtube.com/watch?v=TCa-9SYPIU>

SEISMIC RETROFITTING OF BUILDINGS

Several structures around the country have been designed based on the earlier prevailing codes of practice, which have undergone major revisions over the years. Also, many of them have undergone damage and deterioration due to multiple reasons during the service life which include (but not limited to) change in building usage leading to different load requirement (or enhanced load acting on the structure), construction or design defects, updation of the design standards, seismic events, fire incidents, corrosion ageing of the structure, and lack of inspection and maintenance. One of the primary reasons which cause extensive damage to the structure is the occurrence of earthquake events.

The recent earthquakes across the globe and the extensive devastation caused by them have left everyone in shock. Number of moderate to high intensity tremors have also been experienced in different parts of our country over the last 6 to 8 months. They are one of the most unpredictable hazards.



In India, the landmass has become more and more prone to earthquakes. A total of 2,699 earthquakes with a magnitude of 4 or above have struck within 300 km (186 mi) of India in the past 10 years. This comes down to a yearly average of 269 earthquakes per year or 22 per month.

In wake of this increasing seismic activity, evaluating the adequacy of our existing infrastructure and retrofitting

them to meet the seismic demands is of paramount importance. A proactive approach to improve the building performance to withstand the estimated seismic forces can help to minimize the loss to mankind and the society which is suffered in the event of an earthquake. With this endeavor, National Institute of Disaster Management (NIDM), Ministry of Home Affairs, Govt. of India together with Seismic Academy organized a webinar on “Seismic Retrofitting of Structures” on 12th May, 2023. This was attended by more than 170 enthusiastic participants. The panel was graced by Shri Rajesh Ratnoo, Executive Director, National Institute of Disaster Management (NIDM); Prof. Chandan Ghosh, Head – Resilient Infrastructure Division, National Institute of Disaster Management (NIDM) as the Patron and Guide, respectively.

The esteemed Speakers for the Webinar were Prof. (Dr.) Ajay Chourasia, Chief Scientist and Head of Structural Engineering and 3D Concrete Printing Group, CSIR-CBRI, Roorkee; Dr. Hemant Kumar Vinayak,

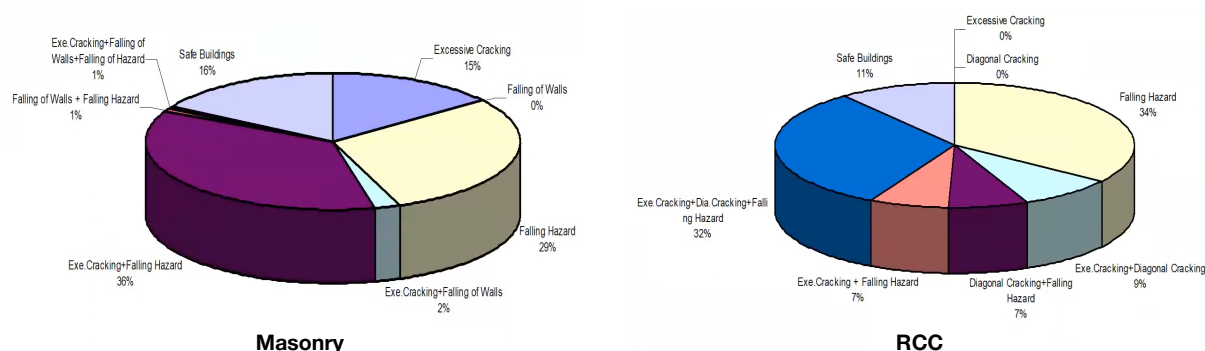
Associate Professor, Dept. of Rural Development, NITTTR, Chandigarh and Mr. Shounak Mitra, Head – Codes & Approval, Hilti India Pvt. Ltd., Delhi. Ms. Avipsha Mohanty, a young professional at Resilient Infrastructure Division, National Institute of Disaster Management (NIDM) acted as the moderator.

The webinar aimed to serve as an opportunity for professionals and academicians to learn and understand the significance of seismic retrofitting to improve building performance and create resilient infrastructure.

Dr. Chandan Ghosh set the stage by emphasizing the need to create awareness on this pertinent topic and encouraged dissemination of knowledge at all levels. He mentioned that with the current seismic vulnerability, it is important to understand and analyze the structural performance, diagnose the existing condition of the structure, and provide an acceptable and implementable solution.

Dr. Ajay Chourasia in his introduction to the presentation on “Seismic Risk Reduction for India – Retrofit of Masonry and RC Buildings” highlighted that the general expectation from one and all is that our habitat should be safe, sustainable, comfortable, economical and socially acceptable. We are moving towards the concept of smart cities where we have uninterrupted lifeline services, education, governance, etc. In the process we forget that in case of any natural hazard like earthquake, the building structure together with its utilities, undergoes the highest level of damage. Hence, we need to be adequately prepared for earthquakes, which can be of low frequency in terms of return period but have high impact in terms of the damage it causes.

He took reference to all the recent earthquakes like Gujarat earthquake, Nepal earthquake and the recent Turkey earthquake, all of which have caused extensive damage to both masonry and RC buildings – both new construction as well as heritage structures. The failure could be attributed to inadequate



connections, inadequate seating and anchorage of roof panels, lack of floor-diaphragm effects, etc. He mentioned that after the Jabalpur earthquake, there was post-earthquake damage assessment conducted wherein it was concluded that almost 85% of the existing buildings were vulnerable to seismic activity. The analysis was carried out for masonry buildings as well as for RCC buildings.

He mentioned that as a general practice it has been observed the essence of the topic is lost and the reaction to it diminishes with passage of time. This was nicely captured in a tabular form.

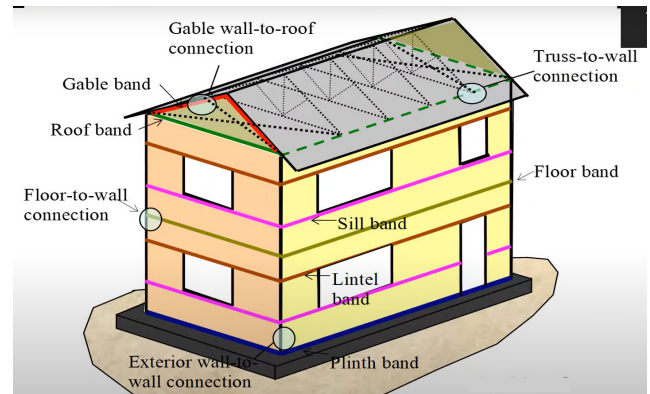
Dr. Chourasia re-emphasized that 59% of the land in India, with a population of almost 78%, is susceptible to seismic events

Stage	Time	Event	Reaction	
			Positive	Negative
1	0 - 1 min	Major EQ		Panic
2	1 min to 1 week	Aftershocks	Rescue and Survival	Fear
3	1 week to 1 month	Diminishing Aftershocks	Short Term Repairs	Allocation of blame to builders, designers, officials etc.
4	1 month to 1 year		Long term repairs, action for higher standards	
5	1 year to 10 years			Diminishing Interest
6	10 years to next EQ			Reluctance to meet costs of seismic provisions etc, Increasing non-compliance with regulations
7	The next EQ	Major EQ	Repeat Stages 1-7	

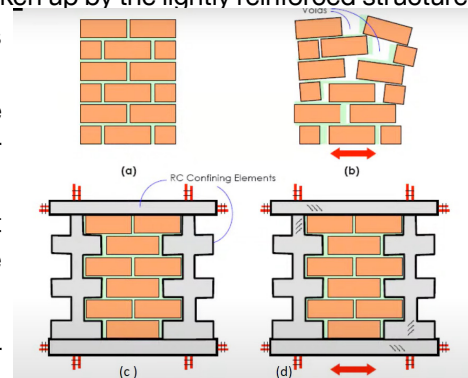
and it is high time that we are adequately prepared to minimize the loss in future events. Among the major challenges which came up in his discussion, techno-legal regime was one, wherein we need to create a sense of urgency among the municipal bodies to be able to regularly monitor the health of the structures in their purview and undertake proper remedial measures to maintain the health of the structure, as and when needed. This would also call for capacity building among the engineers. He enumerated the reasons for collapse and damage as mainly three –

1. Unregulated development of built environment
2. Individual houses are largely self-built
3. Lack of awareness of earthquake standards for design and construction

Further in his presentation, he deliberated on masonry structures and the basic requirements to ensure safety. He highlighted on the requirement of horizontal band and vertical reinforcement in masonry construction to minimize damage due to deformability. Confined masonry is another technique which can ensure seismic resistance. However, majority of the structures on ground are found to be non-compliant. To understand in detail the performance of masonry structures, CBRI undertook full scale investigation for evaluation of performance of masonry structures – unreinforced, reinforced and confined. There has been significant difference in the overall performance which



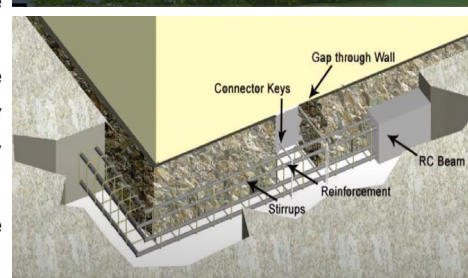
has been observed for confined masonry both from load capacity as well as deformation criteria. For an unreinforced masonry construction subjected to ground shaking, the block work is most likely to bulge out. On the contrary, if it is confined by means of lightly reinforced concrete element, the block work is not likely to collapse miserably, rather the lateral force will be taken up by the lightly reinforced structure. Dr. Chourasia also touched based upon alternate techniques like use of welded wire mesh, chicken mesh, nylon mesh to strengthen the masonry walls. With the use of these arrangements, it is possible to achieve full wall meshing or undertake split bandage, based on requirement. However, these are clearly not to be adopted on prescriptive basis, but reference to relevant standard like IS 1905 to be made to ensure absolute conformity.

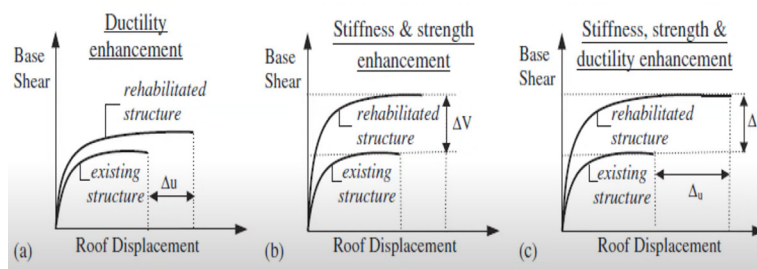
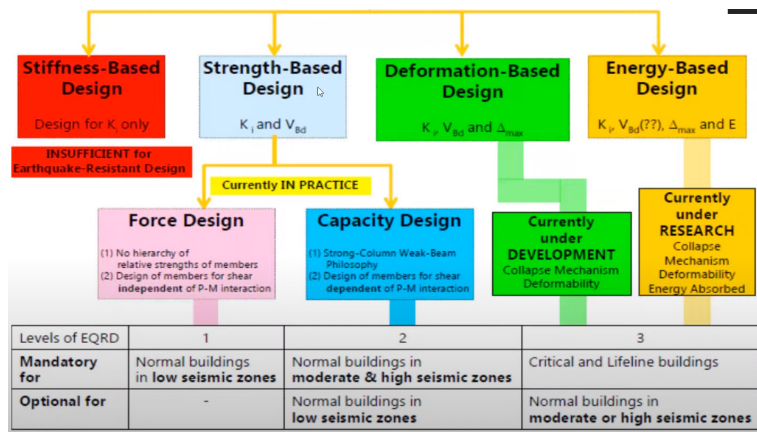


Strengthening of foundations of existing structures is another critical aspect, which includes restriction of drainage system, geotechnical investigation and eventually section enlargement. Reinforcements to be provided adequately and the detailing should be such that the structures are able to behave in unison. He took reference of IS 17848:2022 for design of confined masonry.



In the next segment, he extended his lecture to the design of RC structures wherein he mentioned that the earthquake resistant design approaches have evolved from stiffness based design to the current practice of strength based design and we are gradually shifting toward deformation based and energy based concepts. The current strength based design philosophy follows the seven virtues of earthquake resistant design namely, configuration, stiffness, strength, ductility, deformability, desirable collapse mechanism and energy dissipation capacity.





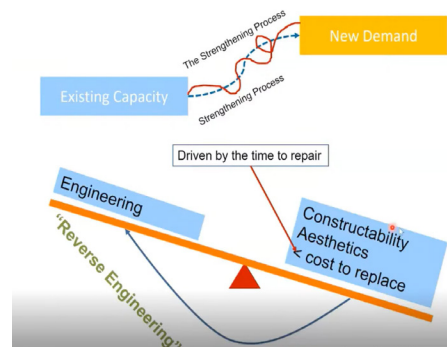
Retrofitting of existing RC structures is a complex process since there is a constraint of parameters like geometry, material, load, etc. The correct retrofitting strategy to be adopted is based on the desired requirement of ductility enhancement or strength enhancement or a combination of both.

Adoption of a retrofitting strategy is also governed by the demand and reverse engineering is performed to make an assessment of the time and cost to restore.

He touched based upon the different retrofitting techniques – both global and local level strengthening which are commonly adopted along with few case studies.

In conclusion, Dr. Chourasia mentioned that there are robust codal provisions in India and we are working towards further development but there is a need for adoption and enforcement. There is a requirement to create local think tanks for implementation of the right practices and create accountability. We also need to in education and capacity building among all stakeholders and encourage community participation.

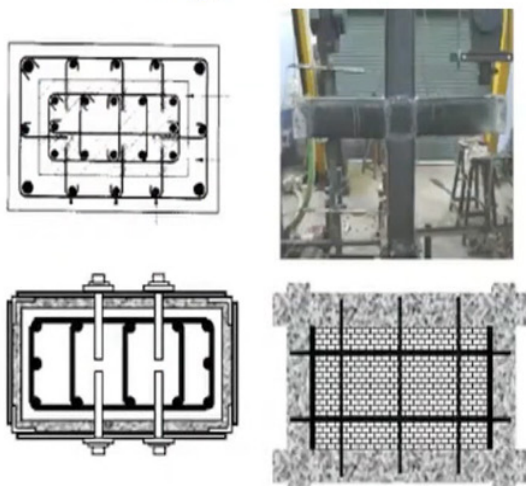
Dr. Hemant Kumar Vinayak in his deliberation highlighted on the different references from Hamirpur during his project under



Methods of Retrofitting

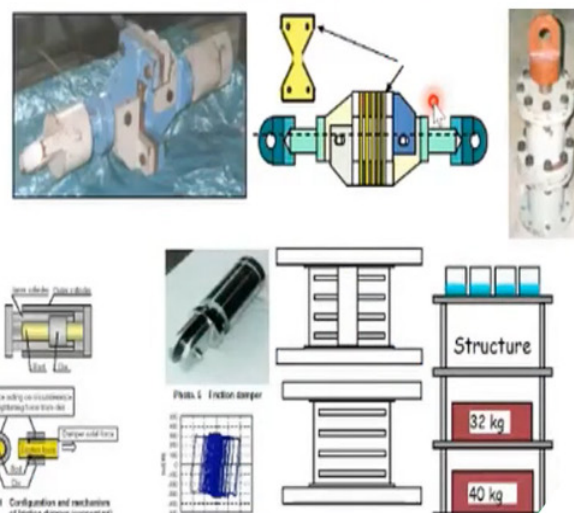
Increase the capacity/strength of the system (Seismic Resistance Base Design)

Concrete Jacketing, FRP Wrapping, Steel Jacketing, Addition of RC Wall



Reduce the demand/force on the system (Seismic Response Control Design)

Elasto-Plastic Dampers, Base Isolators, Lead Extrusion Dampers, Tuned Liquid Dampers



No soil Testing , No calculation, Decision on the spot

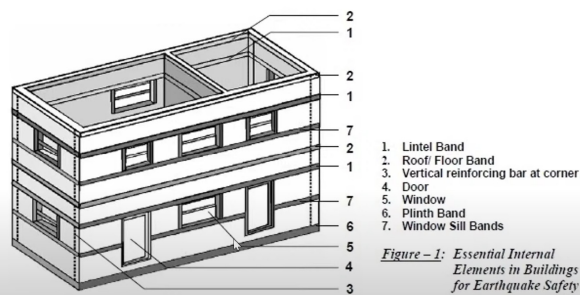


Figure - 1: Essential Internal Elements in Buildings for Earthquake Safety

Himachal Pradesh State Disaster Management in 2012. As a general observation, it was found out that initially the level of construction was below par and with no monitoring. He added that subsequently with regular monitoring and with effort from the local administrator, definite improvement was achieved in the overall construction quality. Drawing reference to Dr. Chourasia's session, he re-emphasized the need for proper detailing in masonry structures and made reference to IS 4326.

In addition to meeting the seismic requirement, he brought up several other factors which may lead to building damage like reinforcement corrosion, differential settlement, water seepage, dampness, improper workmanship. He illustrated with many examples of damage from his experience. Design and construction of row housing is another challenge and can lead to short to long terms defects. While every structure indicates early signs of distress, they are many a time not duly considered, mainly because of ignorance.

Dr. Vinayak, in his concluding remarks, also emphasized on capacity building at every level and cited ignorance/improper knowledge as the prime cause for structural deficiency and collapse.

Dr. Chandan Ghosh concluded the session by appreciating Seismic Academy for taking up this initiative and being an enabler to spread the knowledge. He urged the learned engineering community to come forward and meaningfully contribute to make construction safer.



Seismic Analysis of Tall Buildings using Response Spectrum and Time History Methods

By

Prof. (Dr.) Yogendra Singh

Department of Earthquake Engineering, IIT, Roorkee

The Webinar will also cover -

- Behavior, Design and Detailing of Shear Wall for mirror direction (out of plain local and global bending).
- Boundary Elements...determining width and further Design

Webinar on "Seismic Analysis of Tall Buildings using Response Spectrum and Time History Methods" organized by Epicons Friends of Concrete (EFC) was held on Saturday, 29th April '23 from 03:00 pm to 06:30 pm.

The Webinar also covered -

- Behavior, Design and Detailing of Shear Wall for Mirror Direction (Out of Plain Local and Global Bending).
- Boundary Elements

Speaker - **Prof. (Dr.) Yogendra Singh**, Department of Earthquake Engineering, IIT, Roorkee

Webinar Convener: Mr. Jayant Kulkarni

Moderators: Mr. Anand Kulkarni, Mr. Arvind Parulekar, Mr. R. D. Deshpande

To know more, click - <https://www.theseismicacademy.com/e-learning-detail/evolution-of-earthquake-resistant-design>