Indian Association of Structural Engineers

Bureau of Indian Standards

Jointly organizing the Panel Discussion On

Draft IS Code 1893 (Part 2) Buildings

July 1, 2023 (Saturday), 4:30-6:30 PM (IST)

Lead Speaker

Rupen Goswami
IIT Madras

Panelists

C. V. R. Murty
IIT Madras

Ravi Sinha
IIT Bombay

Arun Kumar S.
BIS

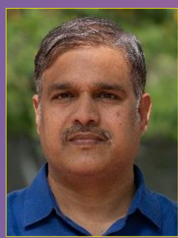
Alpa Sheth
VMS Consultants Pvt Ltd.

Praveen Khandelwal
NTPC

Jitendra K. Chaudhary
BIS

Moderators

Sangeeta Wij
Vice President (North), IAStructE



R. Pradeep Kumar
President, IAStructE

About The Panel Discussion

With rapid strides in earthquake engineering in the last several decades, the seismic codes world over are becoming increasingly sophisticated. Indian seismic codes are no exception. The first Indian seismic code (IS 1893) was published in 1962 and it has since been revised in 1966, 1970, 1975, 1984, 2002 and 2016. The code is once again revised and the revised draft is currently in wide circulation for comments from wider community. The Part-1 of current code is split into two parts in revised version. Part-1 containing general provisions (applicable to all structures) and Part-2 specific provisions for buildings has been published.

This time, the revision of the seismic code is a quantum jump and brings in many significant changes, introducing many advances that have occurred in the knowledge related to earthquake-resistant design of structures over the last 20 years, since its publication in 2002. Some of these new developments have been incorporated in the 2016 version of the code, while many others have been left out so that the implementation of the code does not become too tedious for Indian professional engineers.

The panel discussion on IS 1893 Part 1 General Provisions was organized on June 17, 2023. IAStructE & BIS are now happy to organise a panel discussion on the Draft code IS 1893 Part 2 Buildings, where the code makers and experts, who piloted this revision, will look at the process of development of the draft code. In the panel discussion, the eminent panellists will discuss the main changes that are proposed in Part-1 of the revised code. This will be followed by an interactive session where participants can directly ask questions to the esteemed panellists and clear their doubts.

DRAFT IS CODE 1893 (PART 2) BUILDINGS

In continuation to the discussion on 17th June, another panel discussion was organized by IS 1893 (Part 2) on 1st July, 2023 delivered by experts in the code committee.

Professor R. Pradeep Kumar, President, IAStructE and Ms. Sangeeta Wij, Member, IAStructE extended a warm welcome to the esteemed speaker, eminent panelists and to all the participants. Prof. Pradeep Kumar set the stage by summarizing three prominent reasons which have led the standardization body to take up this extensive exercise –

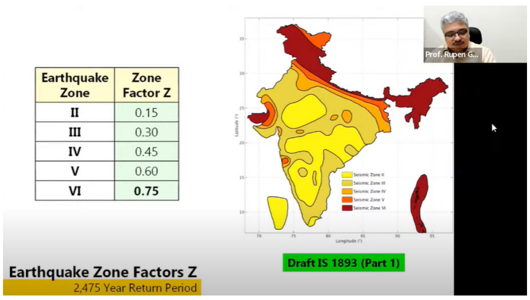
1. In urban areas, there is the prominence of open-ground storey structures and adoption of construction practices which do not meet the requirements of the code;
2. In rural areas, buildings are largely self-built and lack the compliance;
3. Lack of awareness about the right construction practices and specifications.

Ms. Sangeeta Wij broadly highlighted the changes in the standard which include the method of analysis, categorization of buildings, detail on structural systems to be adopted for RCC, steel, masonry buildings, provision of torsional flexibility etc. These are welcome additions which have been formulated based on intense deliberations and she encouraged fellow engineers to follow the guidelines diligently.

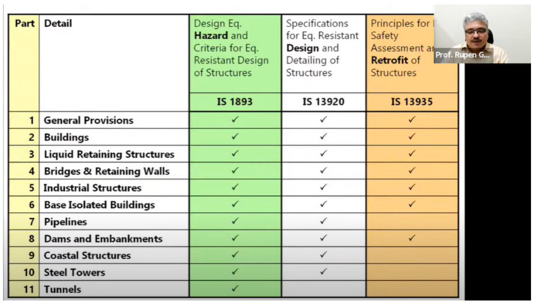
Mr. S. Arun Kumar, Head of Civil Engineering Department (CED), Bureau of Indian Standards (BIS) encouraged the practicing engineers to review the standard for the significant changes which have been made in this refined version.

Prof. Ravi Sinha, IIT Bombay, in his deliberation, highlighted the fact mentioning that changes in standards and construction practices happen because of perceived shortcomings in the existing practice. He touched base on the critical fact that India has more number of people living in high earthquake hazard zone which means more people are at risk of loss of life. Drawing reference from the Turkey earthquake, he mentioned that the magnitude of the earthquake which was experienced was similar to what is considered for design in seismic Zone V. We have been fortunate to have not experienced major catastrophes due to earthquakes in India in the recent past, however, this also means that we learn from real earthquakes in other parts of the country and be better prepared. Life safety is never negotiable and compliance with codes during design and construction ensures that occupants within the building do not lose their life in a codal level earthquake.

Prof. Rupen Goswami, IIT Madras started his session by highlighting the changes which have been made for the seismic zones based on the revised seismic hazard map and for a return period of 2,475 years.



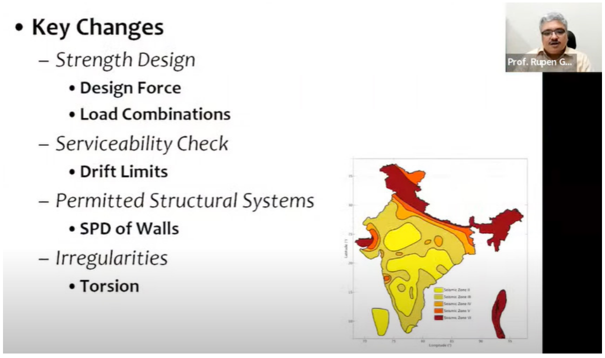
The earthquake standards in the country are being segmented in line with the larger harmonization vision of BIS. Part 2 of IS 1893 talks about all buildings in general, followed by masonry, concrete and steel buildings in the subsequent sections of the document. There are future provisions to include timber, adobe and steel-concrete composite buildings as part of the code.



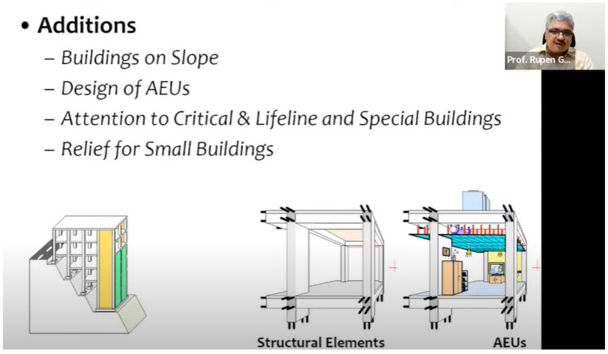
Part	Detail	Design Eq. **Hazard** and Criteria for Eq. Resistant Design of Structures	Specifications for Eq. Resistant **Design** and Detailing of Structures	Principles for Safety Assessment a **Retrofit** of Structures
		IS 1893	IS 13920	IS 13935
1	General Provisions	✓	✓	✓
2	Buildings	✓	✓	✓
3	Liquid Retaining Structures	✓	✓	✓
4	Bridges & Retaining Walls	✓	✓	✓
5	Industrial Structures	✓	✓	✓
6	Base Isolated Buildings	✓	✓	✓
7	Pipelines	✓	✓	
8	Dams and Embankments	✓	✓	✓
9	Coastal Structures	✓	✓	
10	Steel Towers	✓	✓	
11	Tunnels	✓		

He summarized the key changes in the revised standard, with changes in strength design consideration being the most important. Graded approach for serviceability criteria, permitted structural systems (SPD of walls), and guidelines for torsional irregularities being other major changes.

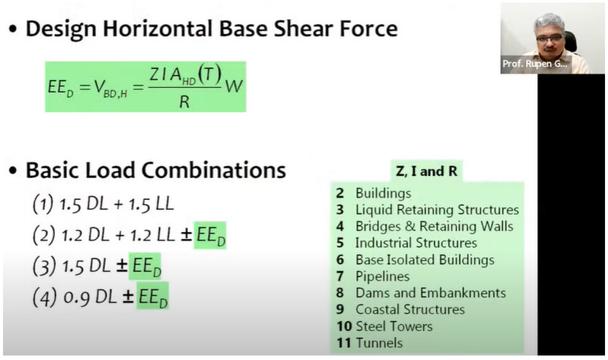
He touched upon the additions which have been made in the standard. With the extensive development of construction in the North-East and in the Himalayan regions, it was perceived as extremely critical to address the safety requirement in those areas. Design on non-structural components has come under the purview of the standard. Attention has been given to critical and lifeline structures. While all these may call for an advanced level of detailing to be carried out, relaxation has been given to small and regular buildings



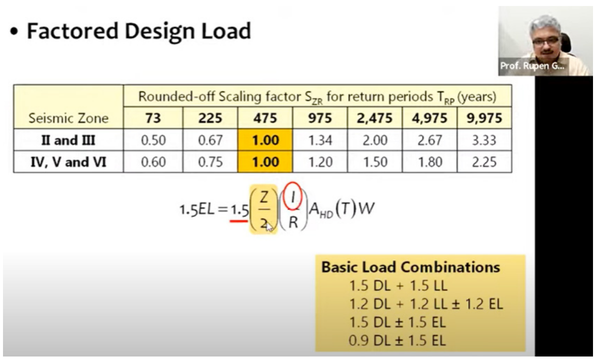
Regarding the strength design, a couple of major changes have been observed in terms of the factors. Based on a more robust and scientific analysis, the estimate of "Z" has been made more rational. Also, the factor on earthquake load has been modified to 1 against an enhancement by 50% as per the current practice.

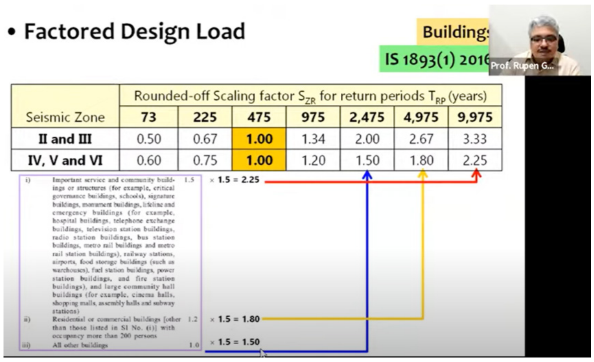


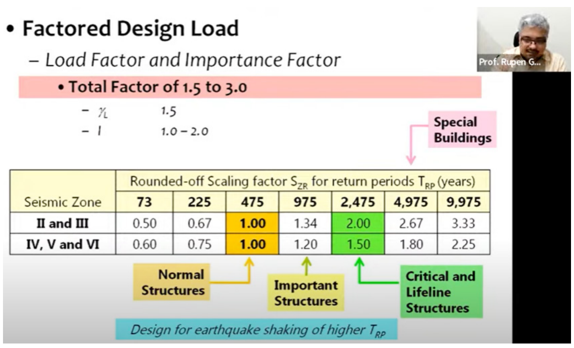
The hazard analysis has been carried out in accordance with international practices and values have been modified to obtain "Z" values for other return periods. The proposal is to consider a return period of 475 years for normal structures, 975 years for important buildings and 2,475 years for lifeline structures. This is the general framework under which IS 1893 is going to operate. Currently, the "Z" value is determined irrespective of the type of building, however going forward, it can be chosen appropriately.

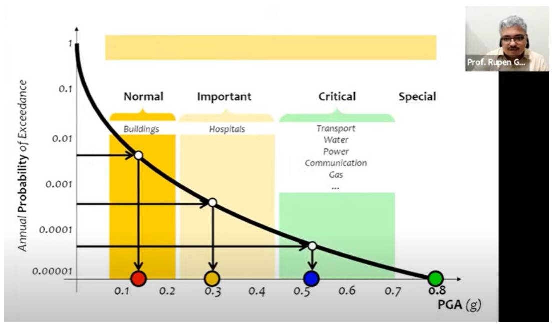


Prof. Goswami further explained the impact of all the influencing factors on the design force for strength design, with sample calculation for the current scenario vis-à-vis the proposed change for normal buildings. This goes well with the general idea.





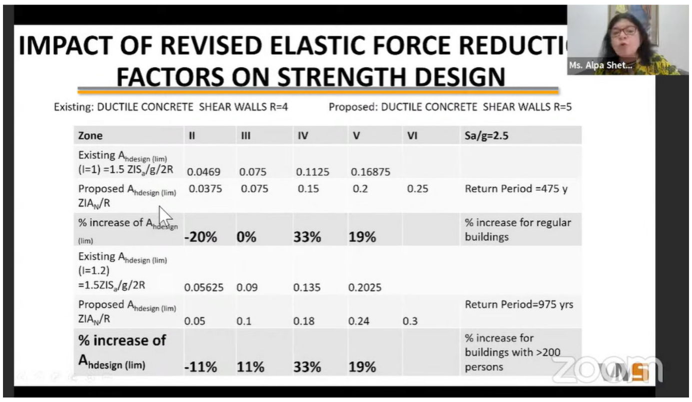


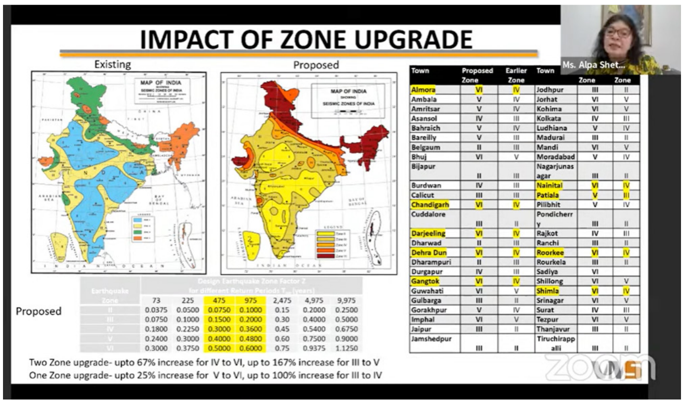


The return period relates to the annual probability of exceedance. For normal buildings, with a design life of 50 years, the probability of exceedance is taken as 10% as per global practice. For important structures, the probability is 5% and for critical structures, it is 2%. For a critical building, there is a higher return period, which indicates a bigger event. This essentially translates to a larger intensity of shaking which can be correlated to higher peak ground acceleration and therefore a higher zone factor.

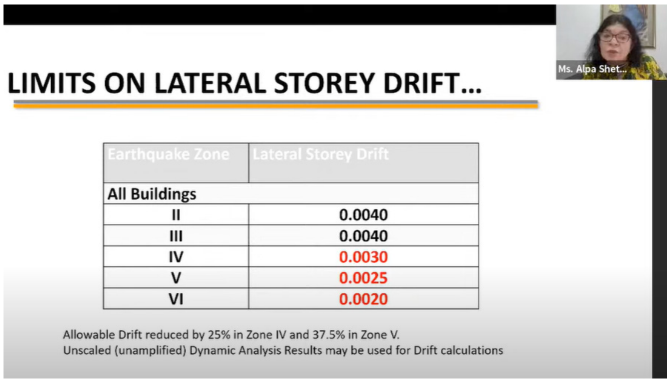
Prof. Goswami shared a comparison of current practices against changes for different scenarios. From his analysis, it was understood that for no change of zone, the increase in horizontal force will range between 25-50% for normal buildings. However, for a change of zone by +1 or +2 levels, amplifications will be higher. A similar analysis was made for important and critical structures.

Ms. Alpa Sheth, VMS Consultants Pvt. Ltd. reinforced the understanding of the topic. She captured the places which would experience the upgradation of the seismic zone due to the revision of the standard. She also highlighted the impact of revised elastic force reduction factors on strength design with elaborate examples.



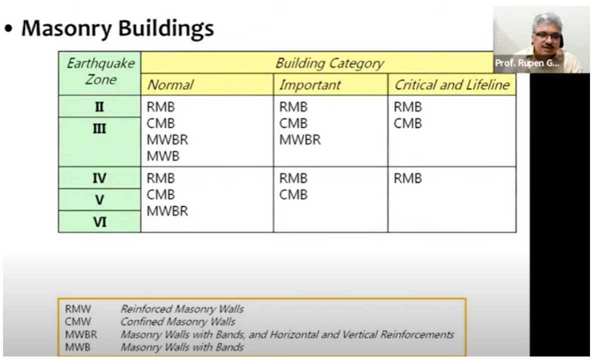


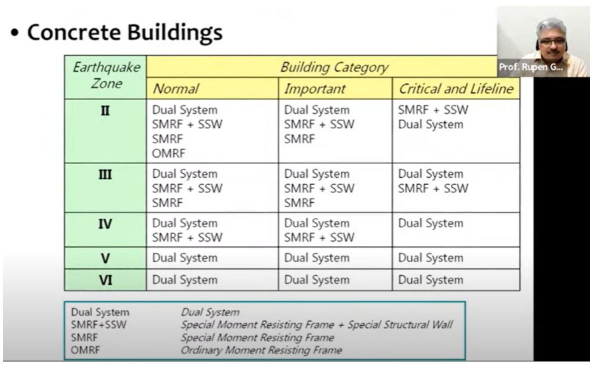
In the serviceability criteria, Prof. Goswami deliberated that for the allowable damage to structures, a graded approach has been adopted with respect to drift limitation. Ms. Alpa Sheth added that the allowable drift has been reduced by 25% for Zone IV and by 37.5% for Zone V.

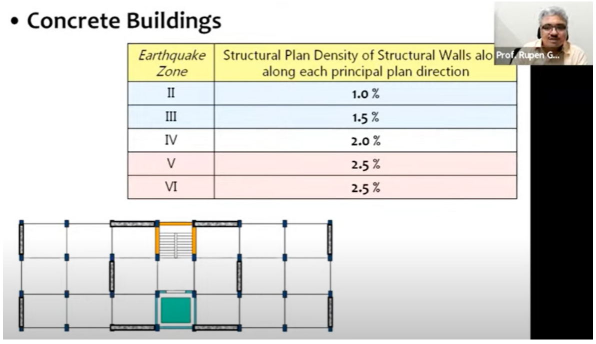


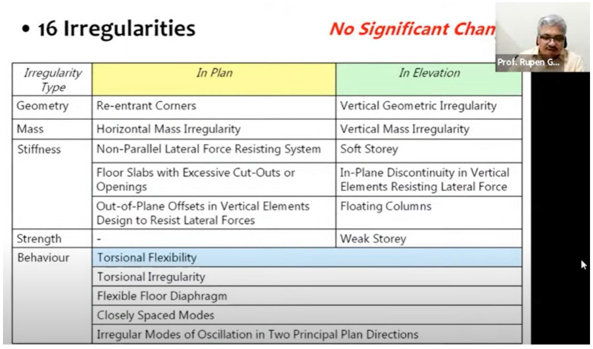
Regarding the structural systems, Prof. Goswami added that depending on the type of structure, lateral load-resisting elements have been prioritized for different zones and building categories. For masonry construction, the primary recommendation is to adopt reinforced masonry or confined masonry, followed by other systems. For reinforced concrete buildings, in high seismic zone, robust lateral systems are recommended and hence the dual system is the preferred approach. A similar provision has been given for steel buildings.

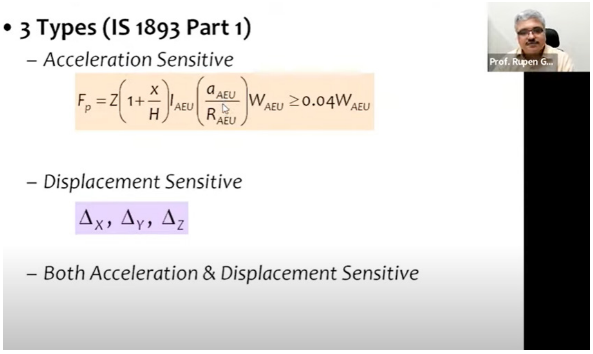
For concrete buildings, another welcome change is the prescription of the structural planned density of walls. In the current practice, a fixed value of 2% is considered in each plan direction.











However, going forward, a graded approach has been adopted, in line with the basic consideration and other design provisions. Another important aspect is building irregularity, which plays a vital role in the seismic behaviour of a structure. No major changes have been made in this regard, except that the provision has been more explicit in the new standard.

An additional requirement of torsional flexibility has been taken into consideration in the proposed revision to factor in the effect of torsional irregularities.

Addition of provision for buildings in slope and inclusion of seismic design for non-structural elements are among the major changes in the proposed revision.

Mr. Praveen Khandelwal, NTPC, touched base on the cost implication which this revision might have on the overall project cost. He mentioned that there is always the total cost and then the civil cost. In projects, where the cost due to civil work is less (e.g. industrial structures), the impact on the overall cost due to revision of the standard will not be large enough to disturb the techno-economic feasibility of the projects. Even for buildings, where the proportion of civil work is comparatively high, the difference may still be anticipated in the reasonable range of 15-20% of the overall project cost. Hence, it is more appropriate to pay due diligence to the adoption of the right design principles.

While answering a few of the questions raised by the participants, Prof C. V. R. Murty mentioned that surprise earthquakes in high seismic zones are of minor consequence while the surprises in low seismic zones are having very high consequence and this has been demonstrated by historical evidence.

When asked whether seismic design is important for a wind sensitive structure, he clarified that even if for a structure, the design wind load is more onerous than the design seismic load, still ductile design and detailing for seismic need to be followed, since design philosophy for earthquake assumes that structure will undergo inelastic deformation, unlike the wind load design philosophy. He added that even within a category of structure, if one wants to distinguish between them, there is an option to marginally enhance the force level, keeping in mind that we don't jump onto the next return period Z-values. And that is the essence of importance factor in the overall consideration as per the revised draft.

The code committee is still open to suggestions from the industry for further refinements and improvements in this regard. Regarding the consideration of architectural elements in a building, he added that any component that is not involved in the load transfer mechanism will be considered as a non-structural element and the relevant clauses will be applicable.

The discussion was followed by a panel discussion where panelists addressed the questions raised by the participants. Mr. Jitendra Chaudhary, Member Secretary – CED 39, BIS gave closing remarks and a vote of thanks.