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A BRIEF STUDY ON THE RECOMMENDATION WITHIN THE AMENDMENT-2 FOR IS 1893 (PART-1): NOVEMBER 2020 FOR THE VARIOUS IRREGULARITY CONCERNS.

[1]Tarak Banerjee,[2]Arya Banerjee

[1]Researcher,[2]Professor

[1,2]Civil Engineering Department

[1,2]Narula Institute of Technology, Kolkata, India

Abstract: A code is primarily designed for structural engineers to stipulate mandatory recommendations while analysing a structure under the influence of seismic excitation. The aim mainly is to make a standard for all to make structures safe and stable, though the seismic parameter during an earthquake is not as equivalent as mentioned in the code, the importance of using the code is there. A structural engineer can save life as strictly following code recommendations can resist the structure from collapse during a ground movement. Throughout the years researchers have developed the code provisions, and it modifies. In November 2020, an amendment for the IS code 1893, Criteria for earthquake resistance design of structures, has been released with some major modifications over previous versions. This study focuses on the latest modifications made and their comparison with the previous version.

***Keywords*–Seismic, amendment2, IS 1893, torsion, re-entrant Corner.**

I. INTRODUCTION

A major modification in form of amendment no.-2 [1] for the sixth revision of IS 1893(Part-I): 2016, Criteria for Earthquake design of Structures [2] has been released by the Bureau of Indian Standards. This code is widely followed by engineers all over India. Code provisions are not constant over time, science develops, code changes. Researchers hard work finds the loopholes in it and code is altered accordingly. With the advancement in seismological equipment, huge data collected during these years, and the knowledge gathered is put on this research to develop the code provisions. Urban planning has changed a lot and the architects draw irregularly shaped buildings to make them more attractive and artistic. Most vulnerable structures are those with such irregularities, if not proper care is taken by structural engineers. These structures require proper analysis and codes recommendations must be followed for design [3]. The amendment no-2 containing a big seven pages of recommendations, various major changes for irregularities are observed.

II. OBJECTIVE

- To study the changes in the new amendment 2 if IS 1893 in comparison with the previous version.
- To describe the advantages of the revisions made for the betterment of seismic analysis of structures for earthquake resistance building.
- To study the impact, it made in the analysis procedure of building under seismic excitation.
- To encourage engineers and researchers about the new code provision to improvise their work.

III. METHODOLOGY

Both the original IS 1893(Part-1) 2016 and its amendment 2020 are studied thoroughly and the recommendation for irregularity in building such as plan irregularity, vertical irregularity, mass, and stiffness irregularities are compared. Only newly recommended guidelines for irregular buildings are discussed.

IV. DISCUSSION

4.1 Torsion

A major change is made for calculating the limit for detection of torsional irregularity [4] is present or not. In the original code, clause 7.1, plan irregularities and vertical irregularities and their limits are tabulated. A building is said to be torsionally irregular if the ratio of the maximum horizontal displacement at one end of the building to the minimum horizontal displacement at the far end in the same direction at a floor level is 1.5. In other words, as Picture 1 shows, Δ_{max}>1.5 Δ_{min}.

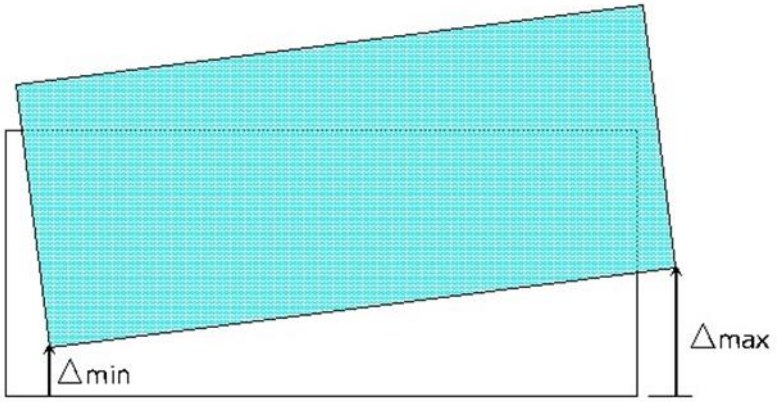

Figure 1. Maximum, and minimum displacement at end of same floor

In the new amendment2, it is mentioned clearly that an additional check must be performed for maximum displacement and that too against the average displacement, not against the minimum displacement in the previous version of the code. If the value of Δ_{max} lies in the range of 1.2 $\Delta_{ave}$to 1.4 Δ_{ave}, where, $\Delta_{ave}= (\Delta_{max}+\Delta_{min})/2$, as shown in Figure 2, the building configuration must be revised such that the natural period of torsional mode shall be lesser than the first two transitional modes in each principal plan directions. If the value lies more than 1.4Δ_{ave}, the building must be revised to provide measures against torsional irregularity, the range was 1.5-2.0 and the limit for further revision was mentioned as 2.0 Δ_{min} in the previous version.

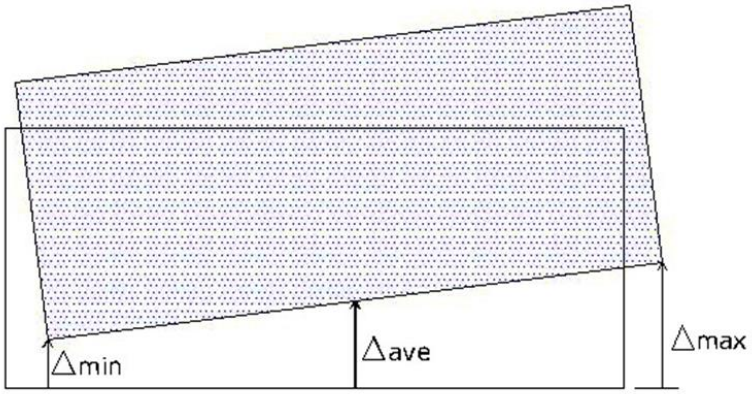

Figure 2. Maximum, minimum, and average displacement of same floor level

4.2 Re-Entrant Corners

In the previous version of the code, it is strictly mentioned, it requires three-dimensional dynamic analysis of there is any re-entrant corner present in the building. In addition to it, the new amendment has introduced the analysis of rigid along with the flexible floor diaphragm analysis to get better information about stress concentration at re-entrant corners and the worst effect shall be considered for analysis.

4.3 Out-of-Plane Offset

A multiplying factor of 2.5 for the forces and the moment due to a seismic action on the connection of two vertical out-of-plane elements placed as offset is introduced in the newer version of the code. The condition for the lateral drift remains the same.

4.4 Stiffness Irregularity

A dynamic analysis is suggested to get the effect of later stiffness distributed along with the height of the building without any condition. A building with stiffness irregularity due to URM infill provision of clause 7.9 shall be used except for a storey with a lower height made for service utilities and stories where outriggers are attached.

4.5 Strength Irregularity (Weak Storey)

A weak storey shall not be permitted as per the new code. However, if the irregularity caused by URM infill, clause 7.10 shall be followed.

4.6 Irregular Modes of Oscillation

As per the new amendment of the code, provisions from the previous code are not applicable for large podiums which are usually made in lower storeys.

V. CONCLUSION

1. Irregularity clauses are explicitly written in the new amendment for IS 1893(P-1) 2016-2020.
2. The additional recommendation for torsional irregularity is a bit confusing. For example, if Δ_{max} and $\Delta_{min}$for a building in a floor level is 10 and 15 respectively, then the initial condition Δ_{max}=1.5Δ_{min} is satisfied as per both versions of the code. According to the new code where Δ_{max}=1.2Δ_{ave}-1.4Δ_{ave} shall be always satisfied and if we get the ratio over 1.2, it will not satisfy the 1.5 ratio condition. Hence introducing the new condition has not change something bigger than before, either both cases will satisfy, or both fail; exceptions are there too.
3. Analysis for stress concentration in diaphragm made mandatory using the flexible diaphragm and rigid diaphragm both.
4. Overall the new amendment makes it stricter structural analysis and given utmost importance to irregularities in building. A great attempt is made considering various research on earthquakes and developments are reflected in the new amendment, shall be very a helpful guide for structural analysis of buildings with new explanations and added recommendations.

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