

Clause no. 11 of IS 13920 : Gravity Columns (Note for Discussion)

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Date : 17-Aug-19

It is mentioned in the code that gravity columns shall be designed for bending & shear when subject to 'R' times the design lateral displacement under the factored equivalent static design seismic loads.

My point of view on Gravity Columns

There are many practical difficulties being experienced for design of the gravity columns based on the above clause. I have received questions from many engineers about the same. I have tried to answer it in the most simple language below. The note is created for sharing my point of view and for initiating the discussion.

The code allows to consider that certain columns may not be designed as earthquake resistant elements. Such columns shall be considered as gravity columns. Actual earthquake force on the structure may be significantly higher than what we consider in the design. Due to this fact, the structure may experience substantially higher displacements than it is derived in the analytical model. The code reckons that the actual displacement in the structure would be $R \times$ Displacement obtained in the analytical model with **factored** earthquake forces (R is response reduction factor).

Let's try to understand what is **factored** earthquake forces? As discussed above, we are dividing the actual earthquake force by Response Reduction Factor to take in to account ductility, overstrength, etc. It means that we are reducing the earthquake force. Such reduced earthquake force is defined as **Factored** earthquake force in the **clause of gravity column**. However, the actual displacement in the structure would be based on the actual force and the gravity columns should be able to withstand the forces induced due to the higher displacement. For this reason, the code defines to design gravity columns for the induced forces due to $R \times$ Displacement obtained from the factored equivalent static design seismic loads.

How to design gravity columns based on above details ?

To design gravity columns as per above details, one of the approach is suggested below:

- 1) **Original model** : Gravity columns should be considered as pinned in this model and displacement of structure should be noted for **factored** seismic load case. This model shall be used for design of main frame members except gravity columns.
- 2) **Model for design of gravity columns** : In this mode, gravity column should be considered as rigid joint and the overall displacement of "R" times that of obtained from original model to be ensured by increase in lateral loads. This model should be used exclusively for the design of gravity columns.